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ABSTRACT

This curriculum guide provides instructional materials for a course to train carpenters who will make careers in construction. It includes 6 sections and 21 instructional units. Each unit of instruction consists of eight basic components: performance objectives, teacher activities, information sheets (content essential for meeting the cognitive objectives), assignment sheets (applications of knowledges which are prerequisites to skill development), job sheets (procedures to complete a manipulative or psychomotor skill), transparency masters and supplements, tests, and test and assignment sheet answers. Depending on specific objectives, the unit may include transparency masters, supplements, assignment sheets, or job sheets. Section A has one unit--Introduction to Residential Construction. Section B, Foundations, contains three units: Concrete Foundations, Wood Foundations, and Special Applications. Section C, Forming, contains two units: Footing and Foundation Forms and Edge Forms. The four units in section D, Framing, are Floor and Sill Framing, Wall and Ceiling Framing, Roof Framing, and Special Framing. Section E, Exterior Framing, has five units: Cornices and Gable Ends, Roof Finishes, Exterior Walls and Trims, Windows, and Exterior Doors. Section F, Interior Finishing, contains six units: Insulation, Dry Wall, Interior Walls and Ceilings, Interior Doors and Trims, Cabinet Installation and Special Built-ins, and Floor Finishes. (YLB)

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Residential Carpentry

Written by
Laborn J. "Bud" Hendrix, Curriculum Writer
for
The Associated General Contractors of America
Washington, D.C.
and
Curriculum and Instructional Materials Center
State Department of Vocational and Technical Education
Stillwater, Oklahoma

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John Folks, Chairman
Francis T. Tuttle, Director

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RESIDENTIAL CARPENTRY

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FOREWORD

In 1972, The Associated General Contractors of America (AGC) met with representatives of the Oklahoma Curriculum and Instructional Materials Center (CIMC) to discuss the possibilities of developing, as a cooperative project, a course of instruction designed for training carpenters who will make their careers in construction.

This publication is the result of those original discussions and the product of close coordination among general contractors, carpenters, people who actually work in construction, and vocational educators. This manual represents a conscious effort to meld the practical experience of personnel in the construction industry with the best instructional methods of those in the field of vocational education.

The trainers of skilled construction workers are faced with the challenge of providing thorough and modern training to the backbone of the construction industry, its work force. The purpose of this manual is to assist instructors in providing a high-caliber instructional program. In 1978, and again in 1983, AGC and CIMC decided that there was a need to update this manual in order to keep up with the ever-changing materials, skills, techniques, and demands of the profession. Therefore, we have revised this manual with these changes in mind. Although the format reflects a systematic approach to instructional materials development and the latest in educational technology innovations, the information in *Residential Carpentry* should be adapted and modified to coincide with local conditions. To make the training process complete, the materials should be coupled with the instructor's own methods, experience, and additional materials.

Dr. Francis Tuttle, Director
Oklahoma State Department of
Vocational and Technical Education

H. Pratt Farnsworth, Jr., Chairman
Manpower and Training Committee
The Associated General Contractors
of America

PREFACE

For many years contractors and those responsible for training carpenters felt the need for instructional materials to be used in training. In 1974, The Associated General Contractors of America (AGC), with the cooperation and support of the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center (CIMC), accepted the challenge and produced a manual for use in training carpenters in those areas in which they are expected to be proficient. In 1978, and again in 1983, AGC and the CIMC decided that there was a need to update this manual in order to keep up with the ever-changing materials, skills, and demands of the profession.

Carpentry instructors are faced with the challenge of providing students with the skill and related information necessary to meet the demands of a changing profession. Competition for jobs is greater than ever. Therefore, the carpenter must be better trained and better equipped to find and retain meaningful employment. This is why AGC and CIMC felt a need to revise and update this manual.

Instructional material in this manual is written in terms of student performance, using measurable behavioral objectives. This is an innovative approach to teaching that accents and augments the teaching/learning process. Criterion-referenced evaluation instruments provide for a uniform measurement of student progress.

The purpose of this manual is to assist carpentry instructors in providing instruction throughout the industry. This publication should be supplemented by each instructor's methods and materials. Any information in this manual that does not concur with the instructor's course of study should be modified to meet personal needs.

ACKNOWLEDGEMENTS

Appreciation is expressed to the many individuals who contributed their time, talents, and knowledge in the preparation of the revision of this manual.

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H. Pratt Farnsworth, Jr., Chairman
Manpower and Training Committee
The Associated General Contractors of America
Pratt Farnsworth, Inc.
Metairie, Louisiana

William K. Healy
Carpentry Curriculum Ad Hoc Chairman
John E. Healy and Sons, Inc.
Wilmington, Delaware

AGC Committee Members

Gerald F. Friauf
Rinderknecht Associates, Inc.
Cedar Rapids, Iowa

John Friedemann
Training Program Coordinator
AGC/CIMC
Stillwater, Oklahoma

Joyce Hartwell
Allcraft Center, Inc.
New York, New York

S. E. Murphree, Jr.
Gene Murphree Corporation
Houston, Texas

E. A. Proefke
Enterprise Building Corporation
Dunedin, Florida

Richard W. Schwertner
Irvin & Schwertner
Andalusia, Pennsylvania

John A Heffner
Associate Director
Manpower and Training Services
The Associated General Contractors of America
Washington, D.C.

Oklahoma Advisory Committee

Ken Bailey
Novak & Lackey Construction Company, Inc.
Oklahoma City, Oklahoma

Don Boyles
District Supervisor
State Department of Vocational and Technical Education
Stillwater, Oklahoma

Jack Giesen
Apprenticeship Coordinator
Carpentry Apprenticeship Training
Tulsa, Oklahoma

Albert Hiemer
Yordi Construction, Inc.
Oklahoma City, Oklahoma

Robert Hilley
Manager of Development
State Department of Vocational and Technical Education
Stillwater, Oklahoma

Lindel Larison
Carpentry Instructor
Caddo-Kiowa Vocational and Technical School
Fort Cobb, Oklahoma

Burnie (Floyd) Lindley
Carpentry Instructor
Durant High School
Durant, Oklahoma

Joe John Narre
Carpenter
Tulsa, Oklahoma

Kelly Sample
Carpentry Instructor
Tulsa Vocational and Technical School, Memorial Campus
Tulsa, Oklahoma

James Sharpton
Curriculum Specialist
State Department of Vocational and Technical Education
Stillwater, Oklahoma

Gary Smith
Carpentry Instructor
Weatherford High School
Weatherford, Oklahoma

Joe Toney
Retired Carpenter
Tulsa, Oklahoma

Ray Trammel
Harmon Construction Company, Inc.
Oklahoma City, Oklahoma

Milton (Fred) Vaughan
Carpentry Instructor
Cleveland High School
Cleveland, Oklahoma

Ron Weidman
Assistant Coordinator of Carpenters' Apprenticeship Training Program
Tulsa, Oklahoma

Special appreciation is extended to Mark Anderson, manager, Steve Anderson Insulation Company, Stillwater, Oklahoma; Craig Shelton, manager, and Rich Davis, assistant manager, Shelton Lumber Company, Stillwater, Oklahoma; Jim Jameson, independent surveyor, Stillwater, Oklahoma; and Sterling Little, graduate student, College of Architecture, Oklahoma State University, Stillwater, Oklahoma. Appreciation is also extended to Don Boyles, Robert Hilley, James Sharpton, Jim Steward, and Susan Walker, Oklahoma State Department of Vocational and Technical Education, Stillwater, Oklahoma; Edward Shiever, carpentry instructor, Indian Meridian Area Vocational and Technical School, Stillwater, Oklahoma; and Fred Vaughan, carpentry instructor, Cleveland High School, Cleveland High School, Cleveland, Oklahoma. All of these people gave much time and effort to this publication, and without their combined efforts, this publication would not have been possible.

USE OF THIS PUBLICATION

Instructional Units

Residential Carpentry contains six sections and twenty-one instructional units. A standard format was established in 1970 for development of instructional materials for all Oklahoma vocational teachers. This format includes eight basic components that form a unit of instruction: performance objectives, suggested activities for the teacher, information sheets, assignment sheets, job sheets, transparency masters and supplements, tests, and answers to tests and assignment sheets. Depending on the specific objectives, there may or may not be transparency masters, supplements, student supplements, assignment sheets, or job sheets included in the unit of instruction.

All of the unit components "zero in" on measurable and observable learning outcomes. Teachers are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

Units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the teacher will help him or her determine the following

- Amount of material that can be covered in each class period
- Skills that must be demonstrated
    Supplies and equipment needed
    Amount of practice needed
    Amount of class time needed for demonstrations
- Supplementary materials, such as pamphlets and filmstrips, that must be ordered
- Resource people to contact

Performance Objectives (white pages)

Each unit of instruction is based on the performance needed for successful employment in an occupational area. Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the performance necessary to reach the unit objective. Since the objectives of the unit provide direction for the teaching/learning process, it is important that teachers and students have a common understanding of the intent of the objectives.

The objective sheet should be given to students and referred to throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objectives can also help determine teaching strategies and instructional methods. Prepare for each unit by deciding how each objective can best be taught.

The objective sheet may also be used as a quick pretest to determine students' prior knowledge and to determine whether further study or activities are necessary. Teachers should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When changes in objectives are made, the teacher should remember to supply the needed information, assignment and/or job sheets, and criterion test items.

Suggested Activities and Supplements (pink pages)

Suggested activities are included only in teacher materials. The suggested activities pages include an outline of the unit contents and an instructor's guide designed to assist teachers in planning their presentation of the unit. The instructor's guide provides suggestions for delivery and/or presentation during the instructional process. Read the suggested activities before teaching the units so that supplemental materials can be obtained, audiovisual materials prepared, and outside resources contacted. Duties of the teacher will vary according to the particular unit.

The references that are listed in the suggested activities are ones used in the development of each unit. They may be used by the teacher to supplement her or his knowledge of the subject area or to help students with particular interests or occupational objectives in the area covered.

The suggested activities section of the unit also includes supplements and transparency masters. Each of these components provides information in a special way. Supplements may consist of motivational materials, review, or practice materials such as charts and reference materials. Supplements are designed to be copied and distributed to individual class members or to the class as a whole. Suggestions for their use are included in the instructor's guide. Transparencies direct the class' attention to the topic of discussion. Transparencies may present new information, or they may reinforce information presented in the information sheet. They are particularly effective when identification or analysis is necessary. Order transparencies from the Curriculum and Instructional Materials Center, or from the Associated General Contractors of America, or make transparencies and place them in the notebook where they will be immediately available for use.

Information Sheet (green pages)

The information sheet provides "must know" content essential for meeting the cognitive (knowledge level) objectives of the unit. The information is written in a topical-outline form and is keyed to the specific objectives.

Teachers will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. The information sheet may also be used for coordination activities and advisory committees.

Students should read the information sheet before the information is discussed in class. Space is provided in margins for students and teachers to add notes that supplement, localize, personalize, or provide motivation for each unit.

Student Supplements (white pages)

Student supplements consist of charts or reference materials that are made available to each class member. Students may use them to complete assignment or job sheets or keep them for future reference.

Assignment Sheets (brown pages)

Assignment sheets give students a chance at problem solving, self-assessment, and/or practical experience. They assist students in the application of knowledges that are necessary prerequisites to skill development. Assignment sheets may be given to the student for completion in class or may be used for homework assignments. Answer sheets are provided when appropriate and can be used by the student and/or teacher for checking student progress. The scores of those assignment sheets listed in the specific objectives should be averaged with the unit test score, as the skills addressed in these assignment sheets are considered necessary in meeting the unit objective.

Job Sheets (blue pages)

Job sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomotor skill. They describe a step-by-step procedure needed to complete each task or job. Diagrams, photographs, and illustrations are provided to assist students in achieving the skill.

The teacher should demonstrate to students the procedures outlined in each job sheet. Furthermore, the teacher needs to localize the job sheet according to the equipment and supplies available in the local lab or shop situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

Job sheet performance should be evaluated by the instructor and averaged with the unit test score, as the skills addressed in the job sheets are considered necessary in meeting the unit objective.

Tests (yellow pages)

The test provides criterion-referenced evaluation of every objective listed in the unit of instruction. It is crucial to note that both paper/pencil and performance objectives must be evaluated.

It is recommended that the tests be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered. A selection of questions from the units covered may be used for final tests at the end of each term if desired. If objectives have been added, deleted, or modified, be sure to make the changes on the test.

The acceptable response on a unit test, 85 percent in most units, may be raised or lowered to fit the topic or students' ability levels. The percentage applies to the overall score, not to each question. The final unit grade should be obtained by using the paper/pencil score and evaluations of student demonstrations of the desired skills.

Answers to Test and Assignment Sheets (pink pages)

Answers to test and assignment sheets are components designed to assist the teacher in evaluation of student performances.

Page Numbering

Each publication from the Curriculum and Instructional Materials Center (CIMC) is assigned a specific abbreviation. For example, *Residential Carpentry* has been abbreviated RC. The units are then numbered consecutively within each section. An example of a page number is RC-1-A. Since CIMC publications are loose leaf, this system of page numbering was adopted so that pages from different manuals would not get mixed up.

Methods of Disseminating Material

Material may be given out a unit or page at a time to keep the material before the student always new. Some teachers ask students to furnish a three-ring binder for the units. This is convenient for taking the materials home to study. Upon completion, each unit is then placed in a larger binder. The large binders may be purchased at cost from the CIMC. Some teachers store the materials by units in filing cabinets or boxes until needed. All the units may be given out at once if desired.

For best results, provide student materials for each student. Student materials contain everything but the test answers, answers to assignment sheets, and suggested activities. All tests are collated at the back of student material and should be removed and stored until needed.

Teaching Methods

It is a challenge to keep students motivated. Supplement the objectives by providing the "why," personal experiences, and current information. Prepare for each unit by deciding how each objective can best be taught. Allow students to become involved in preparing and planning.

Competency Profiles

Competency profiles are folders used to document student performance. The profile contains a list of the specific job competencies that a student should achieve prior to leaving the training program. Competency profiles may be ordered from the State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, and from The Associated General Contractors of America, 1957 E. Street N.W., Washington, D.C. 20006.

CORRECTIONS AND SUGGESTIONS

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To ensure that the material is updated on a timely basis, it is important that you notify the CIMC of necessary corrections as soon as possible after discovering the error. Do not assume that someone else will notice the error and inform the CIMC; other users may be making the same assumption. Please send corrections and recommendations for improving this publication to the following address:

Assistant Coordinator for Development
Curriculum and Instructional Materials Center
Oklahoma State Department of Vocational and
Technical Education
1500 West Seventh Avenue
Stillwater, Oklahoma 74074

INTRODUCTION TO RESIDENTIAL CONSTRUCTION
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to discuss residential construction and framing. The student will show this knowledge by completing the assignment sheet and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with residential construction.
2. Define *framing*.
3. Label the basic parts of a house.
4. Identify framing styles.
5. Arrange in order the logical sequence of the various phases of construction for a one-story structure.

INTRODUCTION TO RESIDENTIAL CONSTRUCTION
UNIT I

SUGGESTED ACTIVITIES

I. Instructor's guide to introducing manual and course

A. Review entire manual and plan presentation of unit.

SUGGESTIONS:

- Plan sequence of unit presentation.
- Determine how units must be supplemented or where objectives must be omitted.
- Allot time required for each unit, scheduling class periods and project time.
- Adapt material to methods of presentations, such as classroom sessions, shop time, individualized instruction.
- Make alternative plans for weather delays, scheduling conflicts, equipment breakdowns, etc.
- Discuss materials with advisory committee.

B. Introduce yourself and the course to the class.

SUGGESTIONS:

- Give an overview of the course, using the table of contents for this manual or your planned schedule; relate the unit titles and sections to residential carpentry.
- Invite graduates of your course to talk to the class about how the course qualified them for employment.
- Use a panel of contractors and specialty carpenters to discuss their jobs and work availability for residential carpenters.
- Discuss competency-based education (CBE), relating your teaching methods and the course materials to CBE.
- Explain your evaluation methods and class-management techniques.
- Discuss safety and discipline.
- Review use of tools, tool checkout procedures, and requirements for student-furnished tools.

SUGGESTED ACTIVITIES

- Allow your students to introduce themselves and explain their interest and background experiences in carpentry.

  (NOTE: Use this time to plan the specific needs of each student based on his or her experience.)

C. Discuss design of CIMC materials, using this unit as an example.

SUGGESTIONS:

- Point out the different components and their purposes.

  (NOTE: This unit does not contain a job sheet. You may wish to take a simple job sheet from another unit, such as "Make a Slump Test" in "Concrete Foundations.")

- Show the relationship between the objectives and other components.

  EXAMPLE: Specific Objective #2; Information Sheet, Section II; and Test Item #2 are all related and may be supported by assignment sheets, job sheets, and supplements.

- Discuss the use of performance verbs in objectives as described in "Use of This Publication."

  EXAMPLE: Point out that *label* and *identify* will require students to work with illustrations.

- Discuss the purposes of *notes* and *cautions*.

- Emphasize that unit tests cover the information outlined in the information sheet, those assignment sheets listed on the objective sheet, and all job sheets; point out that material covered in notes and supplements are not evaluated in the written test.

- Explain any special uses you make of the materials and how the materials accommodate those practices.

  EXAMPLE: If the students are allowed to keep the materials, explain how to take notes to supplement materials in the space allowed by the outline format and how to insert additional materials because of the loose-leaf design.

II. Unit contents

A. Objective sheet

B. Suggested activities

SUGGESTED ACTIVITIES

C. Supplement #1 — Logical Sequence for Construction of a One-Story Structure

D. Information sheet

E. Assignment Sheet #1 — Identify Phases in the Logical Sequence of Construction for a One-Story Structure

F. Answers to assignment sheet

G. Test

H. Answers to test

III. Instructor's guide

A. Review unit and plan presentation.

B. Obtain materials to supplement unit.

1. Compentency profiles

   (NOTE: Competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

2. Make additional copies of supplement if needed.

3. Enlarged poster of Figure 1 in Section III of the information sheet

4. Pictures and plans of houses with various framing styles.

C. Introduce unit.

D. Provide students with objective sheet; discuss unit and specific objectives.

E. Provide students with information and assignment sheets.

F. Discuss information and assignment sheets.

1. Use Information Sheet, Section I to discuss terms and definitions associated with residential construction.

   SUGGESTION:

   - Show actual examples of terms whenever possible, including structural examples in your facility.

SUGGESTED ACTIVITIES

2. Use Information Sheet, Section II to discuss the definition of framing.

   SUGGESTION:

   - Relate framing to the overall construction of a structure and point out how the frame design affects other aspects of the structure, such as footing and foundation, suitability of various exterior finishes, and access to plumbing, insulation, HVAC, etc.

3. Use Information Sheet, Section III to discuss the basic parts of a house.

   SUGGESTIONS:

   - Use an enlarged poster of Figure 1 to discuss the basic parts of a house.
   - Encourage students to comment on what they know regarding construction techniques and materials used in the various parts as well as other terms used to describe the parts of a house.

     (NOTE: This technique provides you with additional information about student backgrounds, allows class leaders to emerge, and prevents advanced students from becoming bored while reinforcing the information for less-advanced students.)

4. Use Information Sheet, Section IV to discuss styles of framing.

   SUGGESTIONS:

   - Post pictures and plans of houses with various framing styles and discuss.
   - Invite a framing carpenter to discuss the tasks of that specialty area and to display some of the tools used.
   - Tour construction sites to view the various types of framing and to introduce the next objective.

5. Use Information Sheet, Section V to discuss the logical sequence of the various phases of construction for a one-story structure. Emphasize those duties that are primarily the responsibility of carpenters.

   SUGGESTIONS:

   - Distribute copies of Supplement #1 and discuss the carpenter's role in the construction process.
   - Discuss the role of the contractor in the construction process.
   - Invite contractors and various types of subcontractors to talk to the class about the phases of construction, emphasizing problems that arise when the various workers fail to communicate and coordinate with each other.

SUGGESTED ACTIVITIES

    - Invite graduates of your course who have gone into specialty areas such as roofing, drywall hanging, and other skills covered in the course to relate the training to their professions.
    - Discuss Assignment Sheet #1.
    - Have students complete Assignment Sheet #1.

G. Review unit.

H. Give test.

I. Critique test and discuss in class.

J. Reteach if necessary.

K. Complete appropriate sections of competency profiles.

IV. Unit references

A. "Foam Core Panel Building Systems." Columbus, Ohio: Delta Industries, Inc., 1984.

B. Hendrix, Laborn J. "Bud". *Commercial Carpentry.* Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1979.

C. Ramsey, Charles G., and Harold R. Sleeper. *Architectural Graphic Standards,* 6th ed. New York: John Wiley and Sons Inc., 1970.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — LOGICAL SEQUENCE FOR CONSTRUCTION OF A ONE-STORY STRUCTURE

Preliminary and groundwork

- ☐ Inspect and clear site; schedule excavator
- ☐ Lay out boundaries and footings
- ☐ Have temporary electricity installed
- ☐ Excavate foundations
- ☐ Build forms for footings; order concrete
- ☐ Have footing forms inspected
- ☐ Pour footings; order windows, doors, and lumber
- ☐ Build forms for foundations; order concrete
- ☐ Have foundation forms inspected; schedule contractor for backfill and trenching
- ☐ Pour foundations; schedule plumbing, heating, and electrical contractors
- ☐ Waterproof; treat for termites; install perimeter insulation and vapor barrier
- ☐ Backfill and trench; schedule mason for chimney and fireplace
- ☐ Install under-floor plumbing, heating, and electrical; have lumber delivered

Framing and roughing-in

- ☐ Start floor and sill frames; order trim, cabinets, and appliances
- ☐ Frame exterior walls
- ☐ Lay up chimney and fireplace
- ☐ Frame interior walls
- ☐ Apply wall sheathing; schedule concrete work
- ☐ Frame ceiling
- ☐ Frame, deck, and dry in roof; schedule mechanical, electrical, and HVAC contractors for rough-in; schedule roofing contractor
- ☐ Install doors, windows, and exterior trim
- ☐ Cut in roof openings
- ☐ Have framing inspected; order insulation and plumbing fixtures; schedule painting
- ☐ Rough in mechanical and electrical work
- ☐ Rough in HVAC work; order underlayment and flooring
- ☐ Have mechanical, electrical, and HVAC rough-in inspected
- ☐ Have roof flashing and finish roofing completed; schedule ceramic-tile contractor
- ☐ Install floor underlayment
- ☐ Install insulation
- ☐ Install drywall
- ☐ Complete concrete site work

Finish and inspection

- ☐ Paint; schedule mechanical and electrical contractors for fixtures
- ☐ Have ceramic tile installed; schedule mechanical, electrical, and HVAC contractors for finish work
- ☐ Install cabinets
- ☐ Install trim and appliances
- ☐ Have mechanical, electrical, and HVAC work completed
- ☐ Install finish floors and carpet
- ☐ Touch up paint and stain
- ☐ Clean up and fine grade
- ☐ Make preliminary inspection
- ☐ Complete requirements from preliminary inspection (punch list)
- ☐ Make final inspection

INTRODUCTION TO RESIDENTIAL CONSTRUCTION
UNIT I

INFORMATION SHEET

I. Terms and definitions associated with residential construction

  A. Structure — Something that is constructed

  EXAMPLES: Building, assembled components of a building

  B. Truss — Structural unit consisting of beams, bars, or ties that are usually arranged to form triangles; provides rigid support over wide spans with a minimum amount of material

  C. Rafter — One of a series of structural members of a roof; designed to support roof loads

  D. Joist — One of a series of parallel framing members that supports floor and ceiling loads and, in turn, is supported by larger beams, girders, or bearing walls

  EXAMPLES: Floor joist, ceiling joist

  E. Girder — Large or principal beam that supports concentrated loads at particular points along its length

  F. Plate — Horizontal structural member that carries the studs on a wall; directly carries the rafters to a roof; or is supported on posts, studs, or corbels to carry the trusses to a roof

  EXAMPLES: Soleplate, top plate

  G. Header — Horizontal structural member that supports the load over an opening such as a window or door

  H. Insulation — Any material that has a high resistance to heat transmission and is placed in structures to reduce the rate of heat flow

  I. Sheathing — Structural covering consisting of boards or prefabricated panels that are attached to the exterior studs or rafters of a structure

  J. Cornice — Exterior trim that is located where the roof meets the wall; usually consists of panels, boards, and moldings

  K. Fascia — Member that is used for the outer face of a box cornice

  L. Lookout — Structural member that runs between the lower end of a rafter and the outside wall, and carries the underside of the overhang

INFORMATION SHEET

M. Soffit — The underside of any structural member other than the true ceiling

(NOTE: Soffits are generally used more to improve appearance than to function structurally. The material used under a roof overhang is a soffit; the curved underside of an arch is usually a soffit, as are false beams. Soffits are also used to finish the space above cabinets; this type of soffit may be done as a *drop ceiling* or a *furr down* in which the finished ceiling or wall surface is even with the top or face of the cabinet.)

N. Gutter — Wood or metal trough that is attached to the edge of a roof to collect and conduct water from rain and melting snow

O. Dry in — To apply building paper or other underlayment that protects roof sheathing and building frame from moisture until finish roofing is applied

P. HVAC — Heat/ventilation/air conditioning

II. Framing — Fitting together and uniting the structural members that give a structure its shape and strength

III. Basic parts of a house (Figure 1)

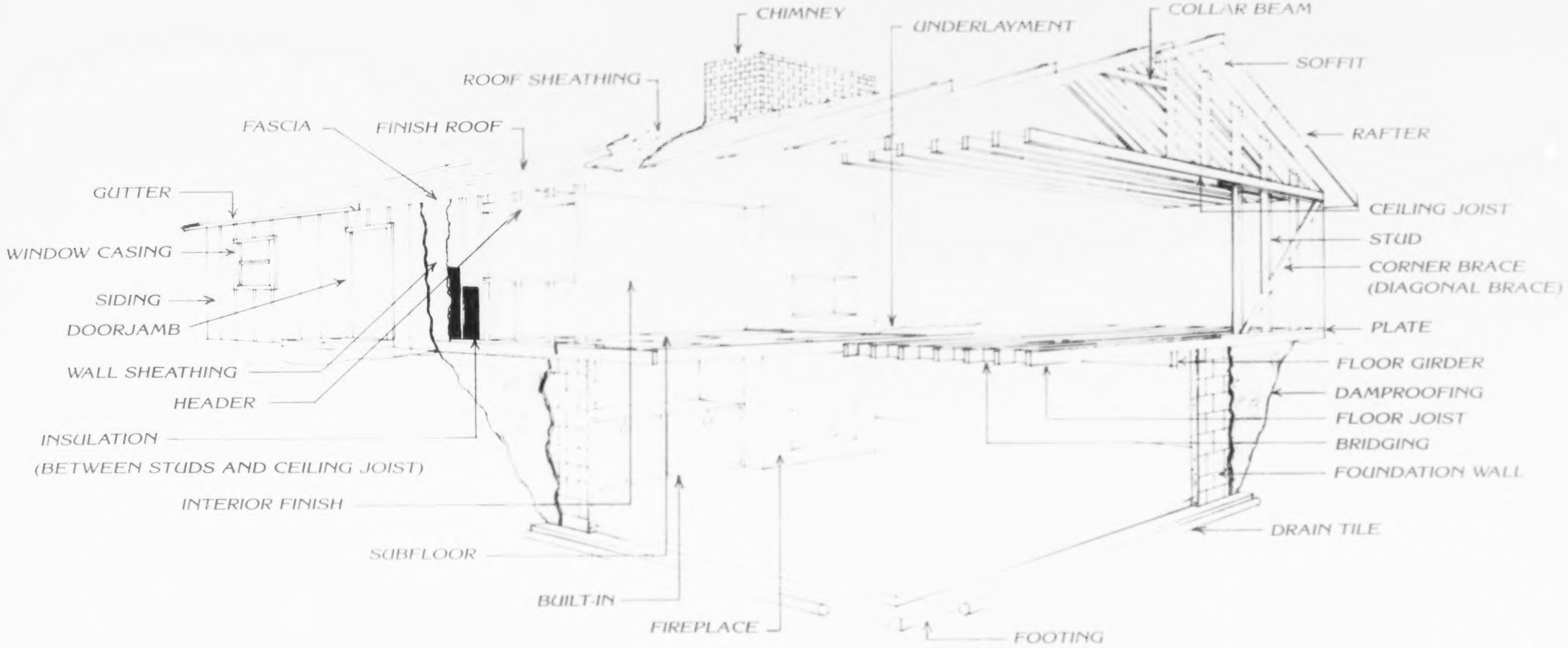

CHIMNEY
UNDERLAYMENT
COLLAR BEAM
SOFFIT
ROOF SHEATHING
RAFTER
FASCIA
FINISH ROOF
GUTTER
CEILING JOIST
WINDOW CASING
STUD
CORNER BRACE (DIAGONAL BRACE)
SIDING
DOORJAMB
PLATE
FLOOR GIRDER
WALL SHEATHING
DAMPROOFING
HEADER
FLOOR JOIST
INSULATION (BETWEEN STUDS AND CEILING JOIST)
BRIDGING
FOUNDATION WALL
INTERIOR FINISH
DRAIN TILE
SUBFLOOR
BUILT-IN
FIREPLACE
FOOTING

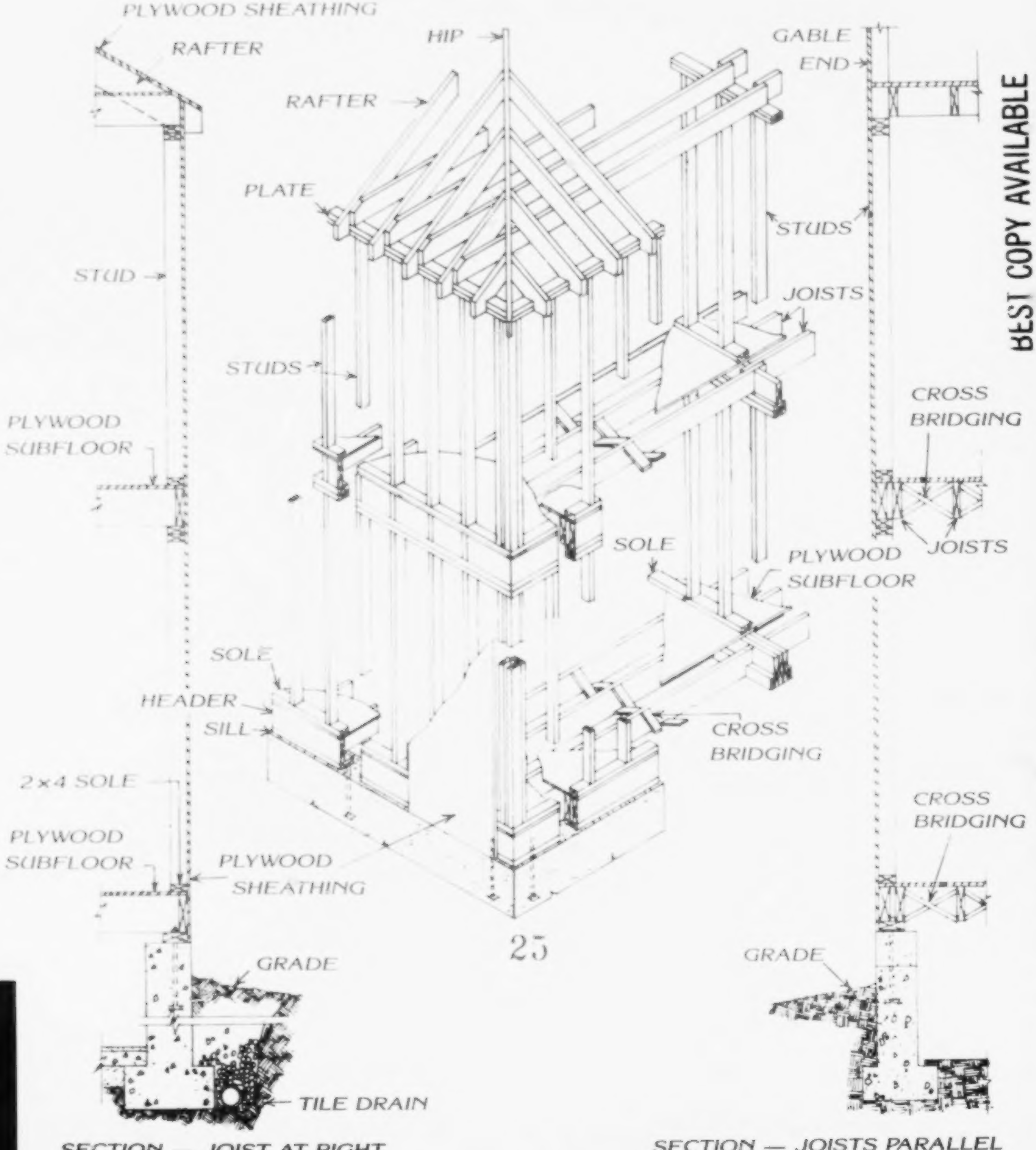
FIGURE 1

IV. Framing styles (Figures 2-5)

A. Western (platform) framing

(NOTE: In western framing systems, the floor joists of each story rest on the top plates of the story below and bearing walls and partitions rest on the subfloor of each story.)

FIGURE 2


PLYWOOD SHEATHING
RAFTER
HIP
RAFTER
PLATE
STUD
STUDS
PLYWOOD SUBFLOOR
GABLE END
STUDS
JOISTS
CROSS BRIDGING
JOISTS
SOLE
PLYWOOD SUBFLOOR
SOLE
HEADER
SILL
CROSS BRIDGING
2×4 SOLE
PLYWOOD SUBFLOOR
PLYWOOD SHEATHING
CROSS BRIDGING
GRADE
GRADE
TILE DRAIN

SECTION — JOIST AT RIGHT ANGLES TO EXTERIOR WALL

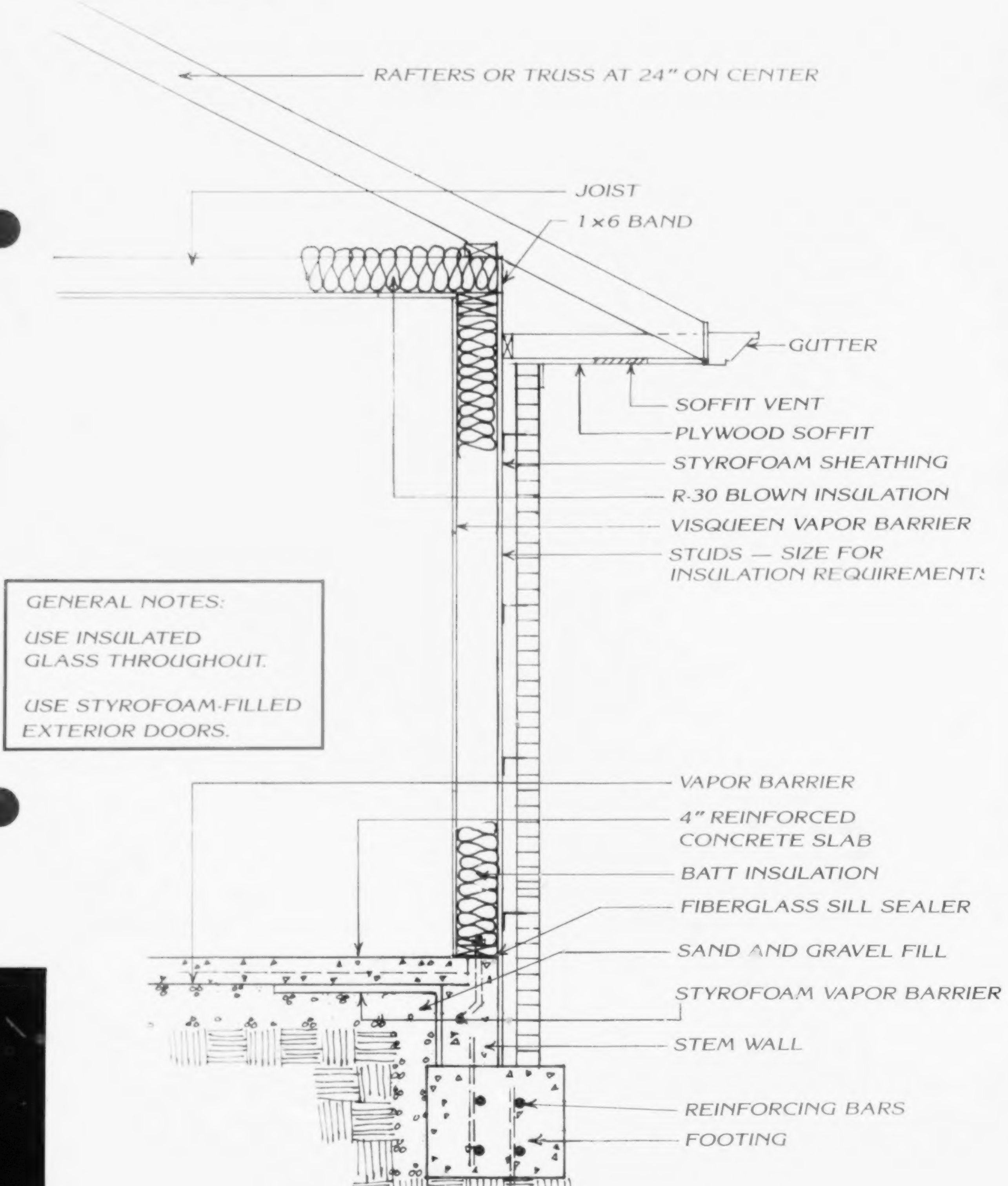
SECTION — JOISTS PARALLEL TO EXTERIOR WALL

BEST COPY AVAILABLE

B. Energy-saving framing

(NOTE: The energy-saving frame allows room for abundant insulation, permits attic ventilation, and makes use of sealants and vapor barriers.)

FIGURE 3


RAFTERS OR TRUSS AT 24" ON CENTER
JOIST
1×6 BAND
GUTTER
SOFFIT VENT
PLYWOOD SOFFIT
STYROFOAM SHEATHING
R-30 BLOWN INSULATION
VISQUEEN VAPOR BARRIER
STUDS — SIZE FOR INSULATION REQUIREMENTS
VAPOR BARRIER
4" REINFORCED CONCRETE SLAB
BATT INSULATION
FIBERGLASS SILL SEALER
SAND AND GRAVEL FILL
STYROFOAM VAPOR BARRIER
STEM WALL
REINFORCING BARS
FOOTING

GENERAL NOTES:

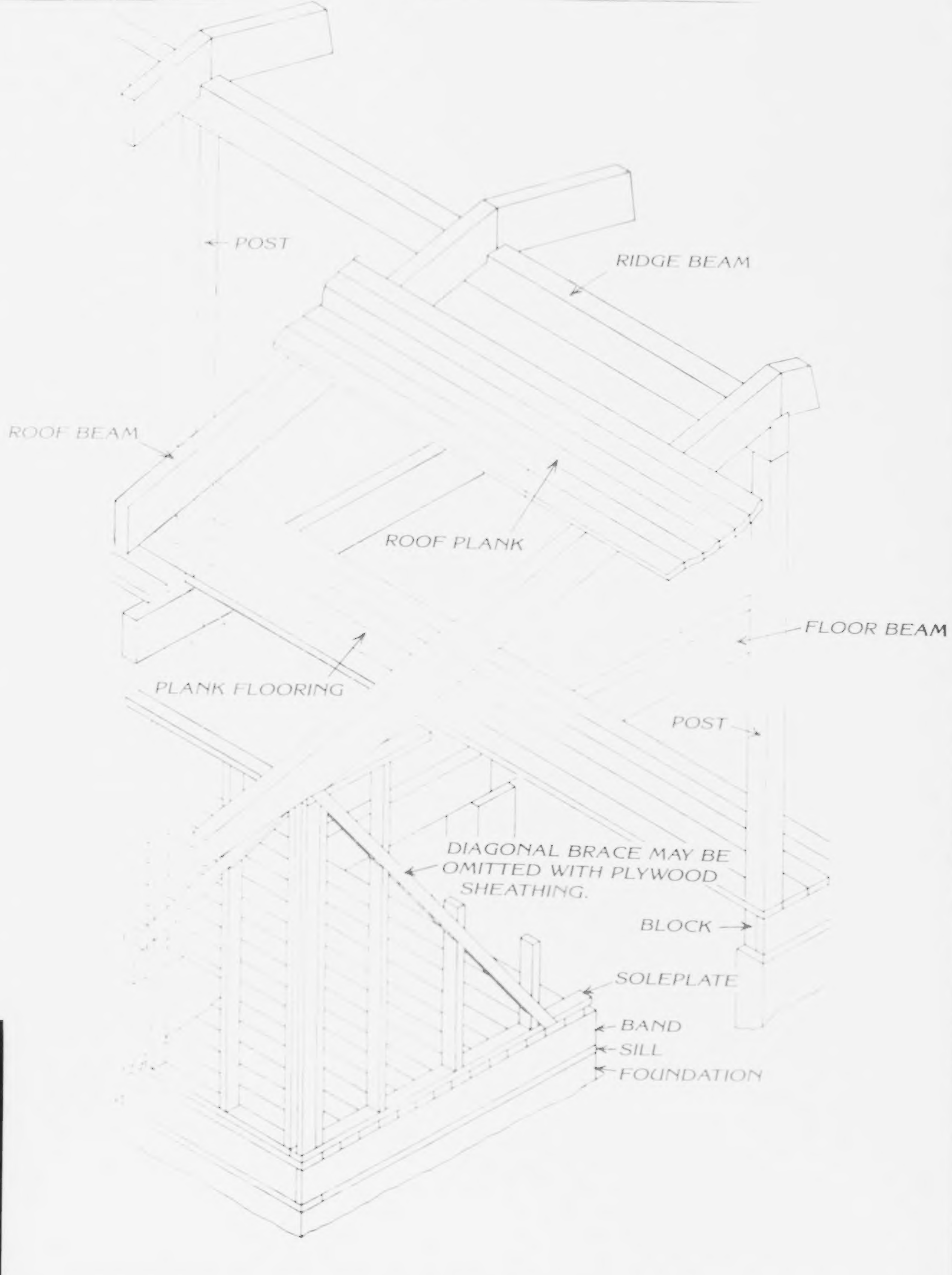
USE INSULATED GLASS THROUGHOUT.

USE STYROFOAM-FILLED EXTERIOR DOORS.

(NOTE: FRAMING DIMENSIONS WILL VARY IN DIFFERENT LOCALITIES AS WILL THE INSULATION.)

C. Plank-and-beam framing

FIGURE 4


POST
RIDGE BEAM
ROOF BEAM
ROOF PLANK
FLOOR BEAM
PLANK FLOORING
POST
DIAGONAL BRACE MAY BE OMITTED WITH PLYWOOD SHEATHING.
BLOCK
SOLEPLATE
BAND
SILL
FOUNDATION

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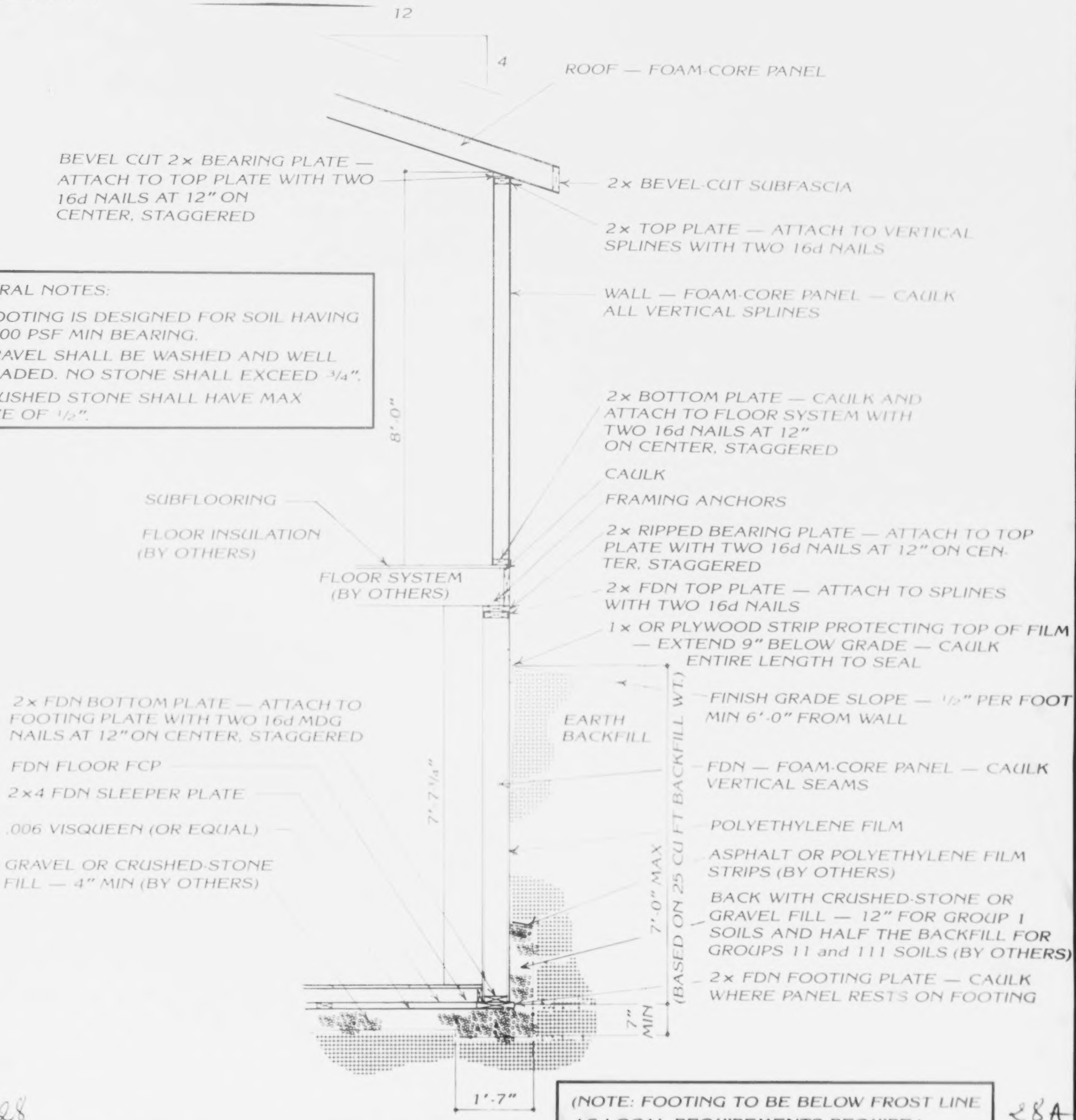
D. Foam-core-panel building system

INFORMATION SHEET

(NOTE: Foam-core panels [FCPs] are structural sandwich assemblies consisting of a lightweight core laminated between two relatively thin, strong facings that can be installed quickly and easily with limited labor.)

FIGURE 5


12
4
ROOF — FOAM-CORE PANEL
BEVEL CUT 2× BEARING PLATE — ATTACH TO TOP PLATE WITH TWO 16d NAILS AT 12" ON CENTER, STAGGERED
2× BEVEL-CUT SUBFASCIA
2× TOP PLATE — ATTACH TO VERTICAL SPLINES WITH TWO 16d NAILS
WALL — FOAM-CORE PANEL — CAULK ALL VERTICAL SPLINES
8'-0"
2× BOTTOM PLATE — CAULK AND ATTACH TO FLOOR SYSTEM WITH TWO 16d NAILS AT 12" ON CENTER, STAGGERED
CAULK
FRAMING ANCHORS
SUBFLOORING
FLOOR INSULATION (BY OTHERS)
2× RIPPED BEARING PLATE — ATTACH TO TOP PLATE WITH TWO 16d NAILS AT 12" ON CENTER, STAGGERED
FLOOR SYSTEM (BY OTHERS)
2× FDN TOP PLATE — ATTACH TO SPLINES WITH TWO 16d NAILS
1× OR PLYWOOD STRIP PROTECTING TOP OF FILM — EXTEND 9" BELOW GRADE — CAULK ENTIRE LENGTH TO SEAL
2× FDN BOTTOM PLATE — ATTACH TO FOOTING PLATE WITH TWO 16d MDG NAILS AT 12" ON CENTER, STAGGERED
EARTH BACKFILL
FINISH GRADE SLOPE — ½" PER FOOT MIN 6'-0" FROM WALL
FDN FLOOR FCP
FDN — FOAM-CORE PANEL — CAULK VERTICAL SEAMS
2×4 FDN SLEEPER PLATE
7'-7¼"
(BASED ON 25 CU FT BACKFILL WT.)
.006 VISQUEEN (OR EQUAL)
POLYETHYLENE FILM
GRAVEL OR CRUSHED-STONE FILL — 4" MIN (BY OTHERS)
ASPHALT OR POLYETHYLENE FILM STRIPS (BY OTHERS)
7'-0" MAX
BACK WITH CRUSHED-STONE OR GRAVEL FILL — 12" FOR GROUP I SOILS AND HALF THE BACKFILL FOR GROUPS II and III SOILS (BY OTHERS)
2× FDN FOOTING PLATE — CAULK WHERE PANEL RESTS ON FOOTING
7" MIN
1'-7"

GENERAL NOTES:

1. FOOTING IS DESIGNED FOR SOIL HAVING 3000 PSF MIN BEARING.
2. GRAVEL SHALL BE WASHED AND WELL GRADED. NO STONE SHALL EXCEED ¾".
3. CRUSHED STONE SHALL HAVE MAX SIZE OF ½".

(NOTE: FOOTING TO BE BELOW FROST LINE AS LOCAL REQUIREMENTS REQUIRE.)

INFORMATION SHEET

V. Logical sequence of the various phases of construction for a one-story stucture

(NOTE: These steps may vary because of weather conditions, job progress, availability of materials, scheduling of contractors, and preference of contractors.)

A. Preliminary and groundwork

1. Inspect and clear site; schedule excavator
2. Lay out boundaries and footings
3. Have temporary electricity installed
4. Excavate foundations
5. Build forms for footing; order concrete
6. Have footing forms inspected
7. Pour footings; order windows, doors, and lumber
8. Build forms for foundation; order concrete
9. Have foundation forms inspected; schedule contractor for backfill and trenching
10. Pour foundations; schedule plumbing, heating, and electrical contractors
11. Waterproof; treat for termites; install perimeter insulation and vapor barrier
12. Backfill and trench; schedule mason for chimney and fireplace
13. Install under-floor plumbing, heating, and electrical; have lumber delivered

B. Framing and roughing-in

1. Start floor and sill frames; order trim, cabinets, and appliances
2. Frame exterior walls
3. Lay up chimney and fireplace
4. Frame interior walls
5. Apply wall sheathing; schedule concrete work
6. Frame ceiling

INFORMATION SHEET

7. Frame, deck, and dry in roof; schedule mechanical, electrical, and HVAC contractors for rough-in; schedule roofing contractor
8. Install doors, windows, and exterior trim
9. Cut in roof openings
10. Have framing inspected; order insulation and plumbing fixtures; schedule painting
11. Rough in mechanical and electrical work
12. Rough in HVAC work; order underlayment and flooring
13. Have electrical, mechanical, and HVAC rough-in inspected
14. Have roof flashing and finish roofing completed; schedule ceramic-tile contractor
15. Install floor underlayment
16. Install insulation
17. Install drywall
18. Complete concrete site work

C. Finish and inspection

1. Paint; schedule mechanical and electrical contractors for fixtures
2. Have ceramic tile installed; schedule mechanical, electrical, and HVAC contractors for finish work
3. Install cabinets
4. Install trim and appliances
5. Have mechanical, electrical, and HVAC work completed
6. Install finish floors and carpet
7. Touch up paint and stain
8. Clean up and fine grade
9. Make preliminary inspection
10. Complete requirements from preliminary inspection (punch list)
11. Make final inspection

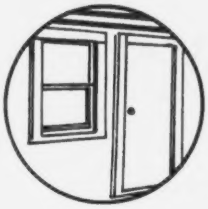
INTRODUCTION TO RESIDENTIAL CONSTRUCTION
UNIT I

ASSIGNMENT SHEET #1 — IDENTIFY PHASES IN THE LOGICAL SEQUENCE OF CONSTRUCTION FOR A ONE-STORY STRUCTURE

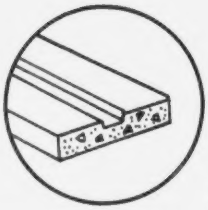
NAME ____ SCORE ________________

The construction of a house requires a great deal of work by many different people. Carpentry is only one part of the whole project. For a house ever to be completed, all the workers involved must work together so that their efforts do not get in the way of each other. Therefore, it is important that the various workers have an idea of what others are doing.

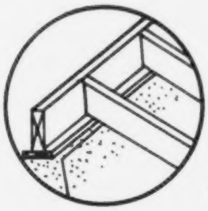
The drawings below illustrate some of the phases in the logical sequence of construction for a one-story structure. Review Section V of the information sheet, and then identify the phase shown in each of the illustrations below and on the following pages. Write the correct names in the blanks. Discuss your answers in class.



A. ______________________________

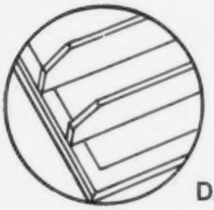


B. ______________________________

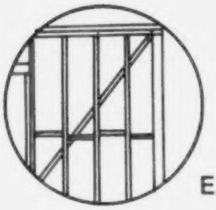


C. ______________________________

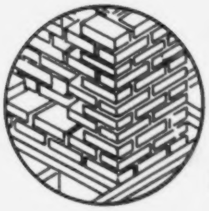
ASSIGNMENT SHEET #1



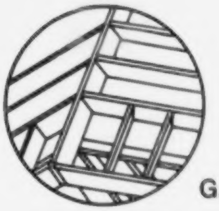
D. ______________________________



E. ______________________________



F. ______________________________



G. ______________________________

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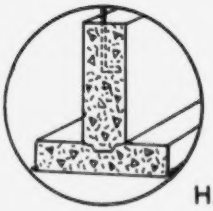
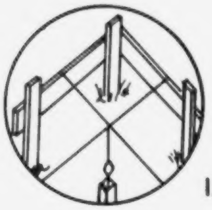
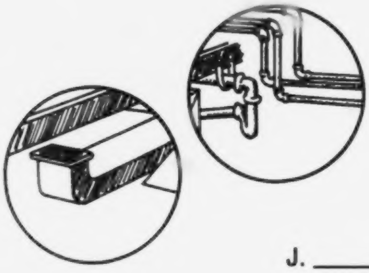


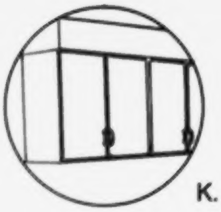
H. ______________________________



I. ______________________________



J. ______________________________



K. ______________________________

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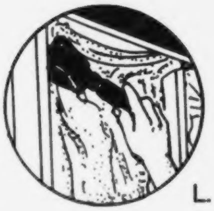
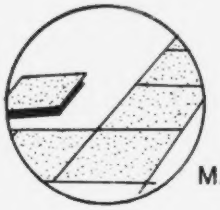
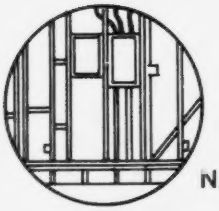


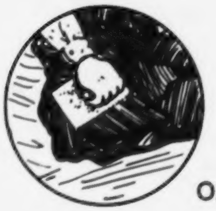
L. ______________________________



M. ______________________________

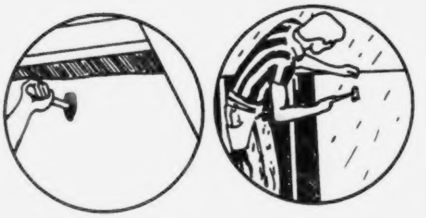


N. ______________________________

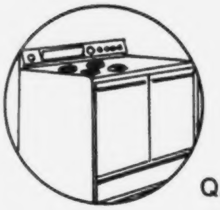


O. ______________________________

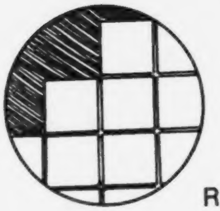
ASSIGNMENT SHEET #1



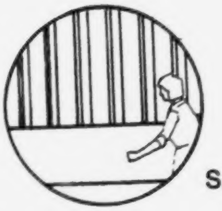
P. ______________________________



Q. ______________________________

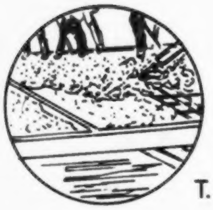


R. ______________________________

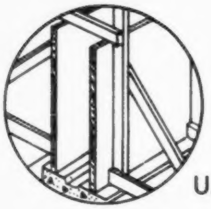


S. ______________________________

ASSIGNMENT SHEET #1



T. ______________________________



U. ______________________________

INTRODUCTION TO RESIDENTIAL CONSTRUCTION
UNIT I

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

A. Install doors, windows, and exterior trim
B. Pour footings
C. Start floor and sill frames
D. Frame ceiling
E. Frame exterior walls
F. Lay up chimney and fireplace
G. Frame roof
H. Pour foundation
I. Lay out boundaries and footings
J. Have mechanical and HVAC work completed
K. Install cabinets
L. Install insulation
M. Install finish floors and carpet
N. Rough in electrical work
O. Waterproof
P. Install drywall
Q. Install appliances
R. Have ceramic tile installed
S. Apply wall sheathing
T. Complete concrete site work
U. Build forms for foundations

INTRODUCTION TO RESIDENTIAL CONSTRUCTION
UNIT I

TEST

NAME ______________________________ SCORE ______________

1. Match to their correct definitions terms associated with residential construction. Write the correct numbers in the blanks. Terms and definitions continue on the next page.

______a. Something that is constructed

______b. Structural member that runs between the lower end of a rafter and the outside wall, and carries the underside of the overhang

______c. Member that is used for the outer face of a box cornice

______d. One of a series of structural members of a roof; designed to support roof loads

______e. To apply building paper or other underlayment that protects roof sheathing and building frame from moisture until finish roofing is applied

______f. Horizontal structural member that supports the load over an opening such as a window or door

______g. Large or principal beam that supports concentrated loads at particular points along its length

______h. Any material that has a high resistance to heat transmission and is placed in structures to reduce the rate of heat flow

______i. Exterior trim that is located where the roof meets the wall; usually consists of panels, boards, and moldings

______j. Structural covering consisting of boards or prefabricated panels that are attached to the exterior studs or rafters of a structure

______k. One of a series of parallel framing members that supports floor and ceiling loads and, in turn, is supported by larger beams, girders, or bearing walls

1. Cornice
2. Girder
3. Fascia
4. Sheathing
5. Header
6. Dry in
7. Insulation
8. Lookout
9. Joist
10. Rafter
11. Structure

TEST

_____l. The underside of any structural member other than the true ceiling

_____m. Horizontal structural member that carries the studs on a wall; directly carries the rafters to a roof; or is supported on posts, studs, or corbels to carry the trusses of a roof

_____n. Wood or metal trough that is attached to the edge of a roof to collect and conduct water from rain and melting snow

_____o. Structural unit consisting of beams, bars, or ties that are usually arranged to form triangles; provides rigid support over wide spans with a minimum amount of material

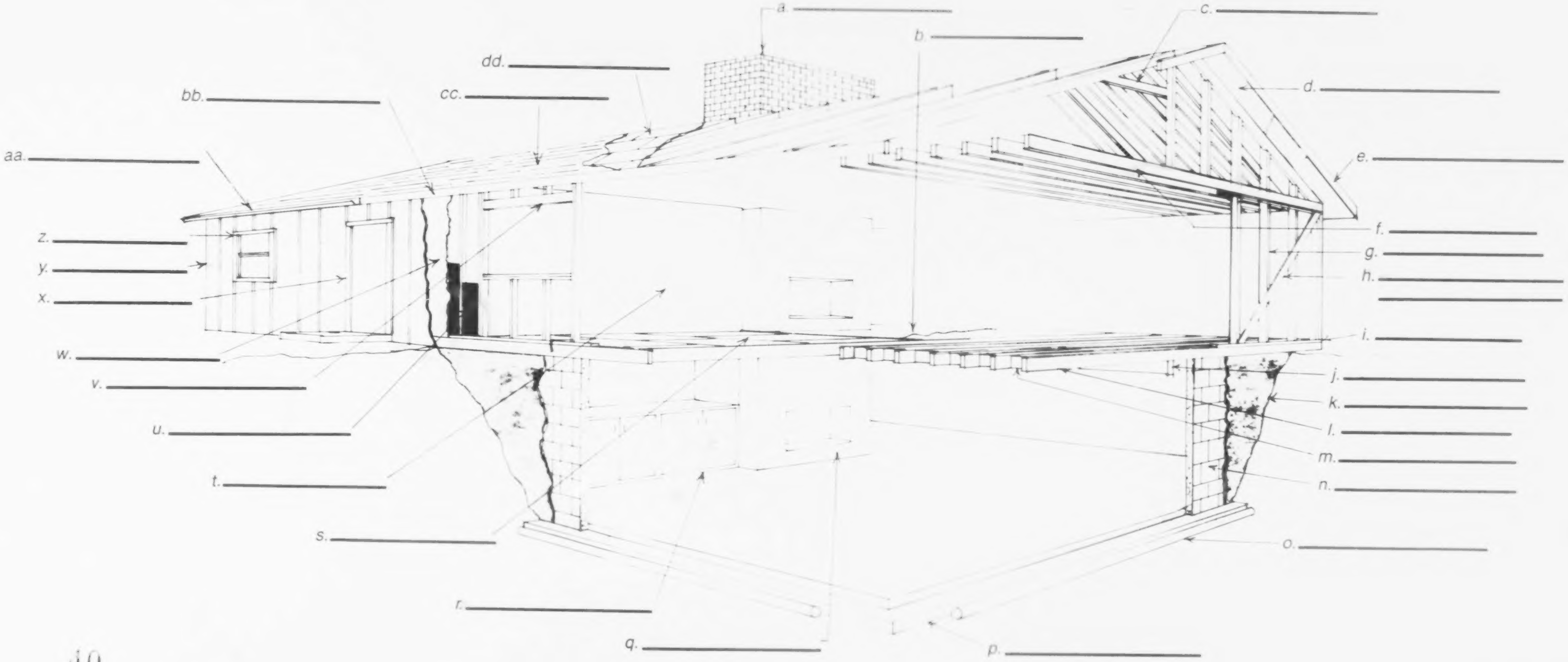
_____p. Heating/ventilation/air conditioning

12. Truss
13. Plate
14. Soffit
15. Gutter
16. HVAC

2. Define *framing*.

TEST

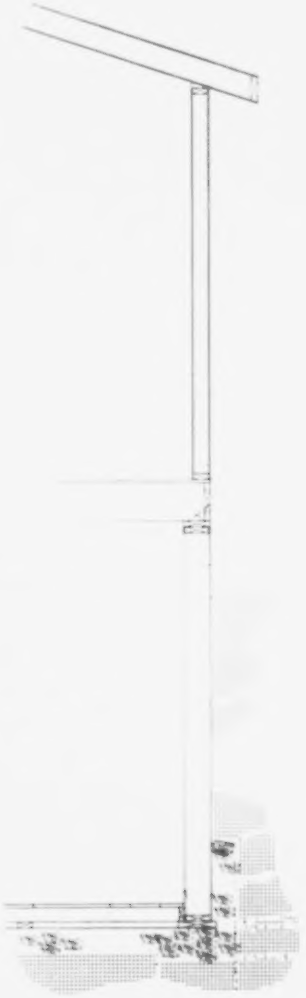
3. Label the basic parts of the house illustrated below. Write the correct names in the blanks.


a. ______
b. ______
c. ______
d. ______
e. ______
f. ______
g. ______
h. ______
i. ______
j. ______
k. ______
l. ______
m. ______
n. ______
o. ______
p. ______
q. ______
r. ______
s. ______
t. ______
u. ______
v. ______
w. ______
x. ______
y. ______
z. ______
aa. ______
bb. ______
cc. ______
dd. ______

TEST

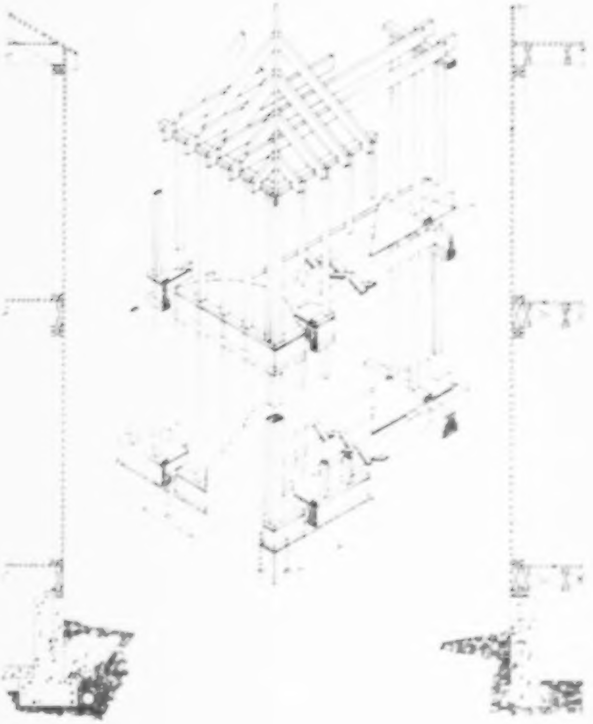
4. Identify the framing styles in the illustrations below and on the following page. Write the correct names in the blanks.

Energy-saving framing	**Western (platform) framing**
Plank-and-beam framing	**Foam-core-panel building system**



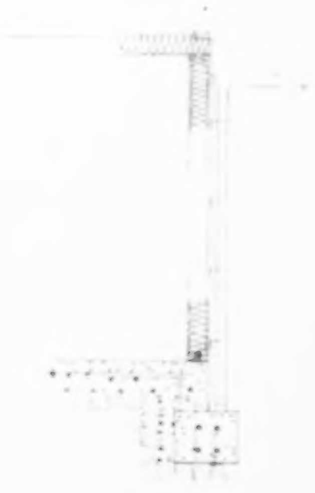
a. ______________________________

TEST



b. ______________________________

c. ______________________________



d. ______________________________

TEST

5. Arrange in order the logical sequence of the various phases of construction for a one-story structure. Write a "1" in the blank before the first step, a "2" in the blank before the second step, and so on for each section below.

Preliminary and groundwork

______a. Excavate foundations

______b. Pour footings; order windows, doors, and lumber

______c. Have foundation forms inspected; schedule contractor for backfill and trenching

______d. Install under-floor plumbing, heating, and electrical; have lumber delivered

______e. Inspect and clear site; schedule excavator

______f. Pour foundations; schedule plumbing, heating, and electrical contractors

______g. Build forms for foundation; order concrete

______h. Waterproof; treat for termites; install perimeter insulation and vapor barrier

______i. Build forms for footings; order concrete

______j. Have temporary electricity installed

______k. Backfill and trench; schedule mason for chimney and fireplace

______l. Have footing forms inspected

______m. Lay out boundaries and footings

Framing and roughing-in

______a. Frame ceiling

______b. Rough in HVAC work; order underlayment and flooring

______c. Frame exterior walls

______d. Install drywall

______e. Install doors, windows, and exterior trim

______f. Start floor and sill frames; order trim, cabinets, and appliances

______g. Have roof flashing and finish roofing completed; schedule ceramic-tile contractor

TEST

______h. Rough in mechanical and electrical work

______i. Lay up chimney and fireplace

______j. Install insulation

______k. Frame, deck, and dry in roof; schedule mechanical, electrical, and HVAC contractors for rough-in; schedule roofing contractor

______l. Complete concrete site work

______m. Apply wall sheathing; schedule concrete work

______n. Install floor underlayment

______o. Frame interior walls

______p. Have electrical, mechanical, and HVAC rough-in inspected

______q. Have framing inspected; order insulation and plumbing fixtures; schedule painting

______r. Cut in roof openings

Finish and inspection

______a. Make preliminary inspection

______b. Have mechanical, electrical, and HVAC work completed

______c. Paint; schedule mechanical and electrical contractors for fixtures

______d. Make final inspection

______e. Install finish floors and carpet

______f. Have ceramic tile installed; schedule mechanical, electrical, and HVAC contractors for finish work

______g. Complete requirements from preliminary inspection (punch list)

______h. Install cabinets

______i. Clean up and fine grade

______j. Install trim and appliances

______k. Touch up paint and stain

INTRODUCTION TO RESIDENTIAL CONSTRUCTION
UNIT I

ANSWERS TO TEST

1.
   - a. 11
   - b. 8
   - c. 3
   - d. 10
   - e. 6
   - f. 5
   - g. 2
   - h. 7
   - i. 1
   - j. 4
   - k. 9
   - l. 14
   - m. 13
   - n. 15
   - o. 12
   - p. 16

2. Fitting together and uniting the structural members that give a structure its shape and strength

3.
   - a. Chimney
   - b. Underlayment
   - c. Collar beam
   - d. Soffit
   - e. Rafter
   - f. Ceiling joist
   - g. Stud
   - h. Corner brace (diagonal brace)
   - i. Plate
   - j. Floor girder
   - k. Dampproofing
   - l. Floor joist
   - m. Bridging
   - n. Foundation wall
   - o. Drain tile
   - p. Footing
   - q. Fireplace
   - r. Built-in
   - s. Subfloor
   - t. Interior finish
   - u. Insulation (between studs and ceiling joists)
   - v. Header
   - w. Wall sheathing
   - x. Doorjamb
   - y. Siding
   - z. Window casing
   - aa. Gutter
   - bb. Fascia
   - cc. Finish roof
   - dd. Roof sheathing

4.
   - a. Foam-core-panel building system
   - b. Western (platform) framing
   - c. Plank-and-beam framing
   - d. Energy-saving framing

5. **Preliminary or groundwork**
   - a. 4
   - b. 7
   - c. 9
   - d. 13
   - e. 1
   - f. 10
   - g. 8
   - h. 11
   - i. 5
   - j. 3
   - k. 12
   - l. 6
   - m. 2

   Framing and roughing-in
   - a. 6
   - b. 12
   - c. 2
   - d. 17
   - e. 8
   - f. 1
   - g. 14
   - h. 11
   - i. 3
   - j. 16
   - k. 7
   - l. 18
   - m. 5
   - n. 15
   - o. 4
   - p. 13
   - q. 10
   - r. 9

   Finish and inspection
   - a. 9
   - b. 5
   - c. 1
   - d. 11
   - e. 6
   - f. 2
   - g. 10
   - h. 3
   - i. 8
   - j. 4
   - k. 7

CONCRETE FOUNDATIONS
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to discuss the use of concrete and reinforcing for footings and foundations and be able to make a slump test. The student will show this knowledge by completing the assignment sheets, job sheet, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with concrete foundations to their correct definitions.
2. State principal properties of good concrete.
3. State factors that affect properties of concrete mixture.
4. Discuss differences between rich mix and lean mix.
5. Match types of admixtures used in concrete to their correct functions.
6. State benefits of admixtures in concrete.
7. State reasons for using vibrators in concrete.
8. Select from a list types of vibrators used to consolidate concrete.
9. Write the formula for estimating concrete.
10. Name types of reinforcing used in concrete.
11. Match common rebar numbers to their correct diameter sizes.
12. Select from a list common sizes of welded wire fabric.
13. Label parts of a concrete foundation.
14. Identify types of concrete footings and foundations.
15. Discuss the design of footings and foundations.
16. List steps involved when constructing concrete foundations.
17. Estimate amount of concrete for a footing.

OBJECTIVE SHEET

18. Estimate amount of materials to pour a foundation.
19. Demonstrate the ability to make a slump test.

CONCRETE FOUNDATIONS
UNIT I

SUGGESTED ACTIVITIES

I. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Supplements

      1. S #1 — Air Content for Air-Entrained Concrete

      2. S #2 — Maximum Permissible Water/Cement Ratios for Concrete

      3. S #3 — Typical Slump Ranges for Various Types of Construction

      4. S #4 — Approximate Water Requirements for Mixing Different Slumps and Maximum Sizes of Aggregates

   D. Transparency masters

      1. TM #1 — Slump Test

      2. TM #2 — Ratio of Concrete Mixes

   E. Information sheet

   F. Assignment sheets

      1. Assignment Sheet #1 — Estimate the Amount of Concrete for a Footing

      2. Assignment Sheet #2 — Estimate the Amount of Materials to Pour a Foundation

   G. Answers to assignment sheets

   H. Job Sheet #1 — Make a Slump Test

   I. Test

   J. Answers to test

II. Suggested activities

   A. Review unit and plan presentation.

   B. Order materials and equipment needed to supplement unit.

   (NOTE: A number of films and print materials are available from the Portland Cement Association, 5420 Old Orchard Road, Skokie, IL 60077.)

SUGGESTED ACTIVITIES

C. Obtain transparencies and competency profiles.

(NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/ Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

D. Introduce unit.

SUGGESTIONS:

- Give an overview of the course, explaining the organization of the materials from the foundation to the finished house.
- Visit a construction site to observe a concrete foundation being poured.
- Use Portland Cement Association materials to introduce concrete foundations.

E. Provide students with objective sheet.

F. Discuss objective sheet, relating the objectives to each other and to your introduction of the unit.

G. Provide students with information sheet.

H. Discuss information sheet.

1. Use Information Sheet, Section I to review terms and definitions for Objective #1.

   SUGGESTIONS:

   - Have samples of tools and hardware such as reinforcing and vibrators available to illustrate terms.
   - Use a sample of set concrete to illustrate terms such as *honeycomb* and *aggregate*.
   - Mix a small amount of concrete to discuss terms such as *bleeding*, *slump*, and *workability*.
   - Relate the terms to specific objectives or use to further introduce unit.

2. Use Information Sheet, Section II to discuss principal properties of good concrete.

   SUGGESTIONS:

   - Use samples of concrete to demonstrate properties.

SUGGESTED ACTIVITIES

- Make available to the students posters and publications that describe the properties of concrete.
- Use your demonstration of workability to introduce Section III of the Information Sheet.

3. Use Information Sheet, Section III to discuss satisfactory mix proportions, emphasizing the applications of various mixes and how the mixes affect the properties covered in the previous section.

   SUGGESTIONS:

   - Use Supplements to discuss mix proportions; you may wish to make transparencies of the charts for use in class discussion.
   - Explain air-entrainment and its purpose.
   - Visit a concrete plant to see the various aggregates used and to view the procedures used to produce different mixes.
   - Review Supplements #3 and #4 to introduce students to the slump test; use Transparency #1 and Job Sheet #1 to demonstrate a slump test, and then allow students to practice making slump tests.

4. Use Information Sheet, Section IV and Transparency #2 to discuss rich and lean mixtures.

   SUGGESTIONS:

   - Allow students to study concrete samples with a range of rich and lean mixes.
   - Discuss the need for a variety of mixes; by this point, the students should be able to relate information covered in the unit and student supplements to specific applications.

5. Use Information Sheet, Section V to discuss admixtures and their functions.

   SUGGESTIONS:

   - Have available samples of the various admixtures for the students to study and explain practical matters such as packaging, costs, and specific uses of each admixture.
   - Ask a concrete sales representative or distributor to talk to the class about admixtures.

SUGGESTED ACTIVITIES

- Emphasize the effects of temperature on the satisfactory performance of concrete; discuss the use of admixtures and other precautions for weather conditions.

  EXAMPLES: 1. Wetting down the subgrade, shielding the pour from wind and direct sun, or using cold water or ice in preparing a mix in hot weather

  2. Using insulated forms, protective coverings, enclosures, or heaters for concrete work in cold weather

6. Use Information Sheet, Section VI to discuss functions of various admixtures, emphasizing the use of admixtures in relation to the properties discussed in Objective #2 and the safe, practical use of admixtures.

   SUGGESTIONS:

   - Emphasize that admixtures have specific purposes and that to be beneficial, an admixture must improve the suitability of concrete in a specific application.
   - Relate each benefit to specific admixtures.
   - Invite a representative from an admixture manufacturer or distributor to discuss the use of admixtures.

7. Use Information Sheet, Section VII to discuss the use of vibrators.

   SUGGESTIONS:

   - Mix some concrete and work it with a vibrator to show the action of the vibrator on the mixture; you may want to use a transparent form material on one side to permit students to see action below the surface.
   - Relate the action of the vibrator to the desirable properties of concrete.
   - Stress the safe operation of vibrators, and allow students to practice handling them.

     (NOTE: Throughout the unit, emphasize the safe handling of concrete. Discuss the dangers involved because of the weight of even small quantities of concrete and that strains can easily result while working poured concrete. Provide the students with literature on concrete poisoning, and discuss its dangers and ways of avoiding it.)

SUGGESTED ACTIVITIES

8. Use Information Sheet, Section VIII to discuss types of vibrators, emphasizing the specific uses of each type.

   SUGGESTIONS:

   - Tour a construction site where various types of vibrators are in use, and explain the use of each type.
   - Emphasize the safe use and care of each type of vibrator, stressing the proper cleaning of all equipment and tools used for concrete work.

9. Use Information Sheet, Section IX to discuss estimating concrete.

   SUGGESTIONS:

   - Use Assignment Sheet #1 and #2 to allow student practice.
   - Have a representative from a local concrete company discuss ordering and delivery of concrete.

10. Use Information Sheet, Sections X through XII to discuss types of reinforcing used in concrete, emphasizing foundation and footing applications.

    SUGGESTIONS:

    - Show students samples of the various sizes of rebar and fabric.
    - Visit job sites to see reinforcement in place before pours.
    - Be sure students understand terminology and standard sizes.

11. Use Information Sheet, Section XIII to discuss parts of a concrete foundation.

    SUGGESTIONS:

    - Construct a styrofoam or wooden model of a concrete foundation to illustrate the three-dimensional parts.
    - Explain the principles behind the various parts and their purposes.
    - Visit construction sites to study foundations, using various types observed to introduce Objective #14.

12. Use Information Sheet, Section XIV to discuss types of concrete foundations and footings, emphasizing the types common in your particular area.

    SUGGESTIONS:

    - Discuss the reasons for the various types of foundations.

SUGGESTED ACTIVITIES

- Have the students check blueprints to find examples of the various types of foundations and footings; discuss in class.

13. Use Information Sheet, Section XV to discuss sizes and shapes of footings and foundations.

    SUGGESTIONS:

    - Stress the importance of each factor that influences the size and shape of a foundation.

    - Emphasize those factors that are major considerations in your region, such as the thickness required for slabs.

      (NOTE: Foundation design is covered further in Unit III, including additional information on frost penetration with transparencies that may be used here.)

14. Use Information Sheet, Section XVI to discuss the steps involved in constructing concrete footings, relating the steps to other subjects covered in this course.

I. Review unit.

J. Give test.

K. Reteach and retest as necessary.

L. Complete appropriate sections of competency profiles.

III. Unit references

A. Hendrix, Laborn, J. "Bud." *Cement Masonry.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1975.

B. United States Department of the Interior, Bureau of Reclamation. *Concrete Manual: A Water Resources Technical Publication,* 7th ed. Washington, D.C.: U.S. Government Printing Office, 1966.

C. Wagner, Willis H. *Modern Carpentry.* South Holland, Illinois: Goodheart-Willcox Company, Inc., 1976.

Air Content for Air-Entrained Concrete

Maximum size of coarse aggregate, inch	Air content percent by volume
1-1/2, 2, or 2-1/2	5 ± 1
3/4 or 1	6 ± 1
3/8 or 1/2	7 1/2 ± 1

Maximum Permissible Water/Cement Ratios for Concrete

Specified compressive strength at 28 days, psi	Water required per 94-lb bag of cement, U.S. gallons	
	Non-air-entrained concrete	Air-entrained concrete
2,500	7 - 1/4	6 - 1/4
3,000	6 - 1/2	5 - 1/4
3,500	5 - 3/4	4 - 1/2
4,000	5	4

Ratios include allowance for free moisture on the aggregate.

Typical Slump Ranges for Various Types of Construction

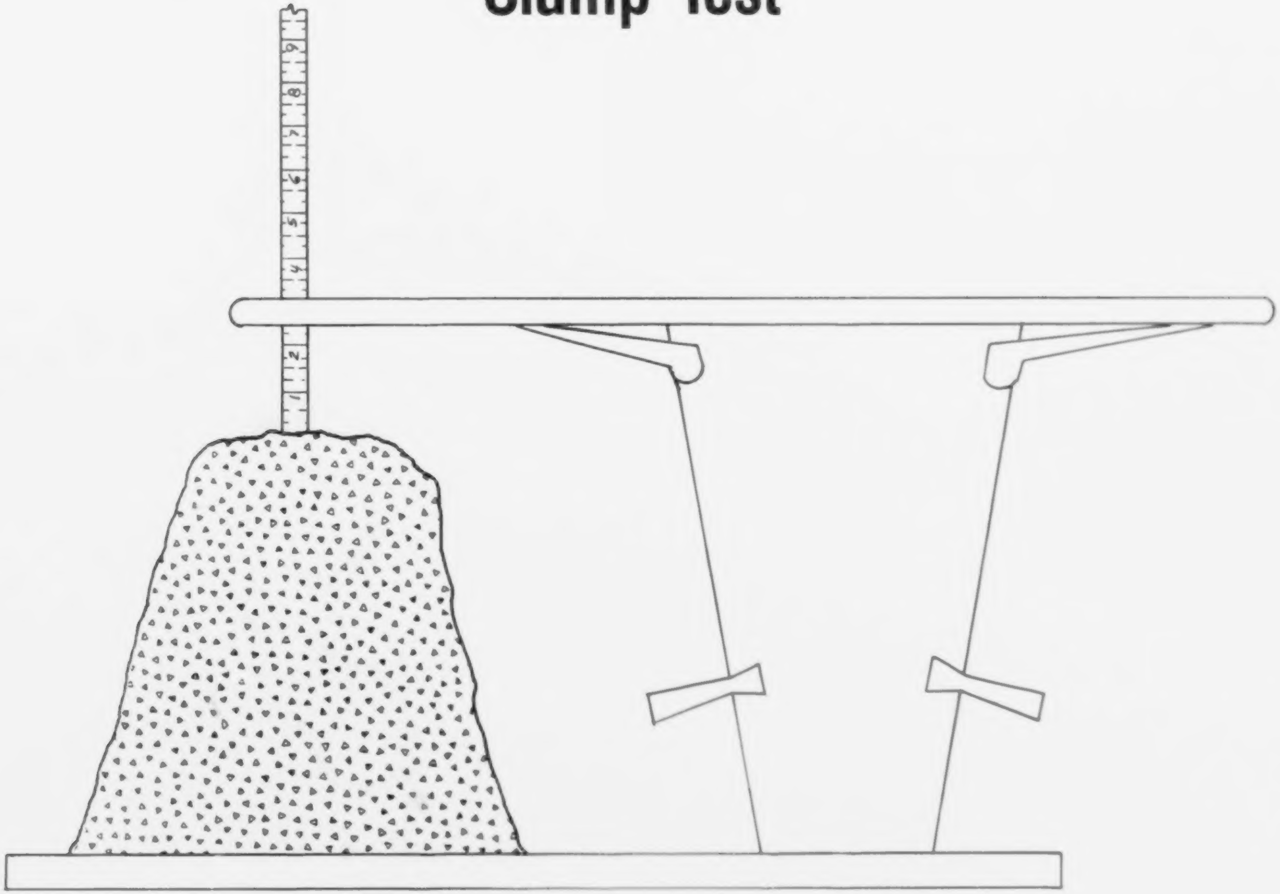
Type of Construction	Slump (Inches)*	
	Maximum	Minimum
Reinforced foundation walls and footings	4	2
Unreinforced footings, caissons, and substructure walls	3	1
Reinforced slabs, beams, and walls	5	2
Building columns	5	3
Pavements	2	1
Sidewalks, driveways, and slabs on ground	4	2
Heavy mass construction	2	1

*When high-frequency vibrators are *not* used, the values may be increased by about 50 percent, but in no case should the slump exceed 6 inches.

Approximate Water Requirements for Mixing Different Slumps and Maximum Sizes of Aggregates

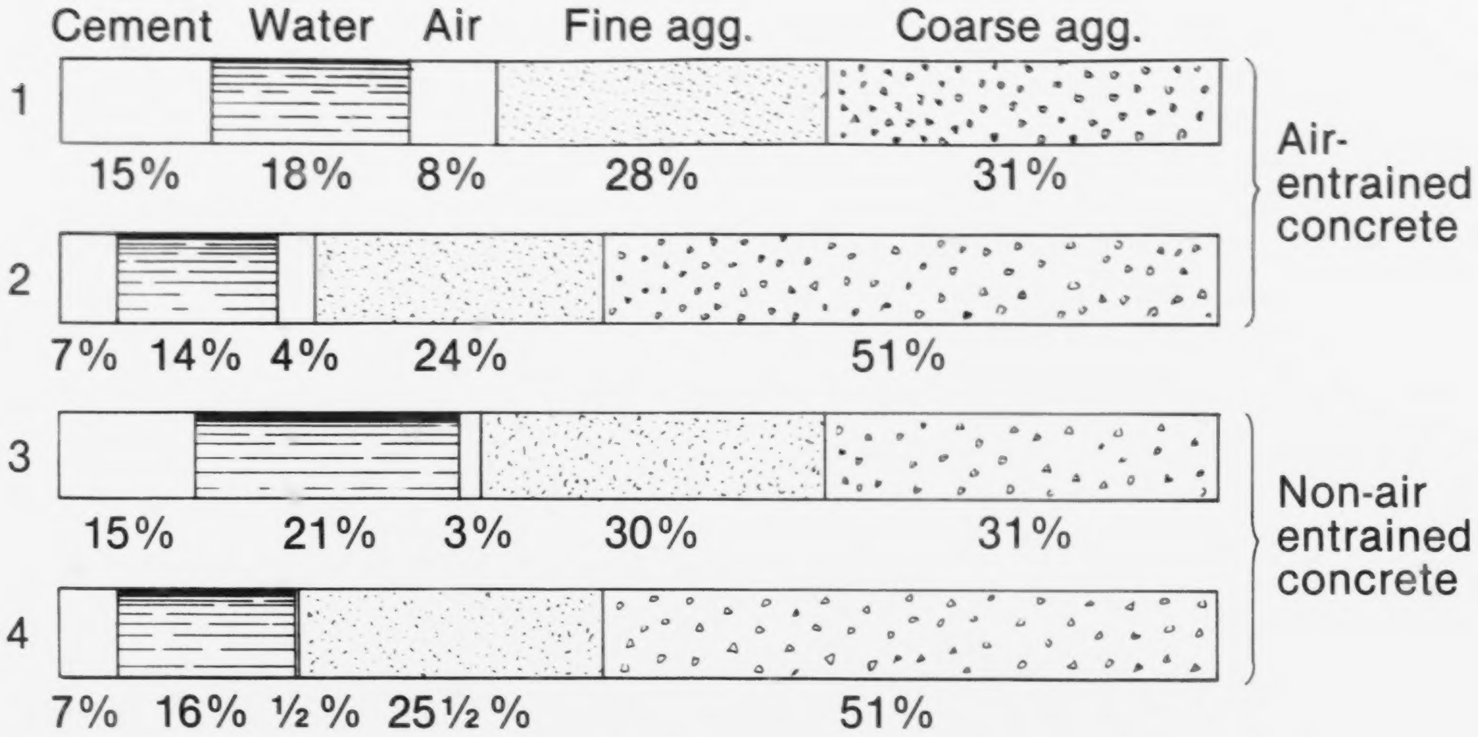
Slump (Inches)	Water for indicated maximum sizes of aggregate (Gallons per cubic yard of concrete)							
	3/8 in	1/2 in	3/4 in	1 in	1-1/2 in	2 in	3 in	6 in
Air-entrained concrete								
1 to 2	37	36	33	31	29	27	25	22
3 to 4	41	39	36	34	32	30	28	24
5 to 6	43	41	38	36	34	32	-	-
Recommended average total air content, percent	7.5	7.5	6	6	5	5	4	3
Non-air-entrained concrete								
1 to 2	42	40	37	36	33	31	29	25
3 to 4	46	44	41	39	36	34	32	28
5 to 6	49	46	43	41	38	36	-	-
Approximate amount of entrapped air in non-air-entrained concrete, percent	3	2.5	2	1.5	1	0.5	0.3	0.2

Slump Test



SLUMP $2\frac{1}{2}$ INCHES

Ratio of Concrete Mixes



Bars 1 and 3 represent rich mixes with small aggregates.
Bars 2 and 4 represent lean mixes with large aggregates.

CONCRETE FOUNDATIONS
UNIT I

INFORMATION SHEET

I. Terms and definitions

  A. Aggregate — Any of several materials used for mixing with cement materials to make concrete

  EXAMPLE: Gravel

  B. Slab — Poured, flat area of concrete

  C. Monolithic slab — Continuous mass of concrete cast as a single unit

  D. Slump — Measure of the consistency of fresh concrete

  E. Workability — Ease with which concrete can be placed, consolidated, and finished

  F. Permeability — Capable of being penetrated by air or water

  G. Bleeding — Process that occurs when water comes to the surface after concrete has been poured

  H. Consolidate — To join ingredients together into a whole

  I. Vibrator — Equipment used to consolidate concrete

  J. Honeycomb — Cavity or air pocket in concrete

  K. Admixture — Substance added to concrete mixture for specific results; added at batch plant

  L. Reinforcing — Steel bars or mesh embedded in concrete so that the two materials act together in resisting forces

  M. Water stop — Flexible, waterproof material cast in place across a concrete joint to prevent passage of water

  N. Cantilever — Projecting beam or member supported at only one end

II. Principal properties of good concrete

  A. Workability

  B. Durability

  C. Strength

  D. Economy

INFORMATION SHEET

III. Factors that affect properties of concrete mixture

  A. Air content

  B. Water/cement ratio

  C. Range of slump

  D. Maximum size of aggregate

IV. Differences between rich mix and lean mix

  A. Rich mix

    1. More cement and water

    2. Less coarse aggregate

  B. Lean mix

    1. Less cement and water

    2. More coarse aggregate

V. Types of admixtures and their functions

  A. Air-entraining admixture — Agent that incorporates microscopic air bubbles into concrete to improve workability and durability

  B. Accelerator — Agent that speeds the setting of concrete

  C. Retarder — Agent that delays setting of concrete

  D. Waterproofer — Agent that helps to seal concrete against water penetration

  E. Color pigment — Agent used to achieve a desired color

  (NOTE: Pigment can be a natural or a man-made substance.)

  F. Water reducer — Agent that increases the fluidity of concrete

  G. Pozzolan — Agent used to improve workability and quality of concrete and to lower cost

  (NOTE: Pozzolans reduce the chemical reaction between the aggregates and the cement used in concrete. The chemical reactions often produce heat, which leads to expansion of the concrete. The expansion weakens the concrete, changes its volume, causes increased bleeding, and makes the concrete more permeable.)

INFORMATION SHEET

VI. Benefits of admixtures in concrete

(NOTE: The number and extent of benefits vary with the admixtures. The list below gives the major benefits possible through the planned use of admixtures.)

A. Increased durability

B. Improved resistance to effects from freezing and thawing

C. Controlled setting time

D. Increased early strength

E. Enhanced appearance

F. Improved workability

G. Less heat generation

H. Lower cost

VII. Reasons for using vibrators in concrete

A. Consolidate concrete into a dense mass

(NOTE: For small pours, concrete is sometimes consolidated by puddling with a long slim board or spade or by tapping on the outside of the form with a block of wood or hammer.)

B. Prevent honeycombing

C. Produce a smooth surface along the forms

D. Consolidate concrete around reinforcing and inserts

VIII. Types of vibrators used to consolidate concrete

A. Lightweight electric immersion-type vibrators

B. Heavy-duty electric immersion-type vibrators

C. Air or pneumatic vibrators

D. Exterior-type form vibrators

E. Medium-duty gasoline vibrators

INFORMATION SHEET

IX. Formula for estimating concrete

$$\frac{\text{Width in Feet} \times \text{Length in Feet} \times \text{Thickness in Feet}}{\text{27 Cubic Feet per Cubic Yard}} = \text{Cubic Yards of Concrete}$$

(NOTE: Concrete is sold by the cubic yard, but most construction dimensions are given in feet and inches. To convert dimensions the easy way to cubic yards, state all lineal dimensions in feet and divide by 27, the number of cubic feet in a cubic yard. Inches should be converted to fractions or decimal fractions of a foot.)

EXAMPLE: Estimate concrete for a 30 foot by 60 foot slab 4 inches thick.

$$\frac{30' \times 60' \times 4''}{27} = \frac{30' \times 60' \times 0.33'}{27} = \frac{594}{27} = 22 \text{ cubic yards}$$

or

$$\frac{30' \times 60' \times 4''}{27} = \frac{30' \times 60' \times {}^{1}/_{3}'}{27} = \frac{600}{27} = 22.22 \text{ cubic yards}$$

X. Types of reinforcing used in concrete

A. Reinforcing bars (rebars)

B. Welded wire fabric (wire mesh)

XI. Common rebar sizes (Table 1)

(NOTE: Rebar comes in standard lengths of twenty feet. If it is necessary to reinforce pours more than twenty feet long, the bars may be lapped and wired together. A lap should be a minimum length of twenty-four times the diameter of the rebar but never less than twelve inches.)

TABLE 1

Rebar Number	Diameter
3	3/8"
4	1/2"
5	5/8"
6	3/4"
7	7/8"
8	1"
9	1 1/8"
10	1 1/4"
11	1 3/8"
14*	1 3/4"
18*	2 1/4"

*Most suppliers do not stock #14 and #18 but can order them.

INFORMATION SHEET

XII. Common sizes of welded wire fabric (Table 2)

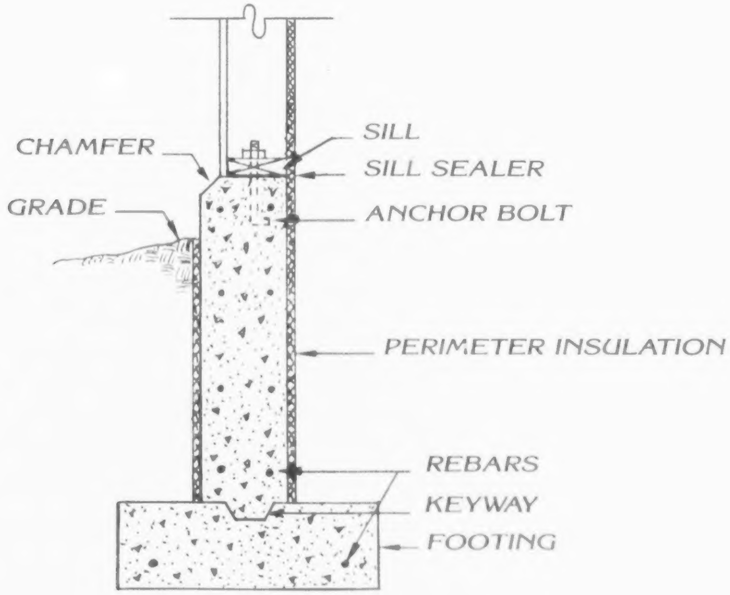
(NOTE: Welded wire fabric, also known as wire mesh, comes in a standard length of 150 feet and a standard width of 5 feet. Thus, there are 750 square feet in a roll. Size is determined by the spacing and gauge of the wire. The first set of numbers shows the number of inches between wires, and the second set of numbers shows the gauge of the wires. For example, 6/6 × 10/10 mesh is made of ten-gauge wire spaced six inches apart in both directions and is referred to as "six, six; ten, ten." Wire mesh should be overlapped at least six inches.)

TABLE 2

2/2	4/4	6/6
2/2 × 14/14	4/4 × 4/4	6/6 × 4/4
2/2 × 16/16	4/4 × 8/8	6/6 × 6/6
	4/4 × 10/10	6/6 × 8/8
		6/6 × 10/10

XIII. Parts of a concrete foundation (Figure 1)

FIGURE 1

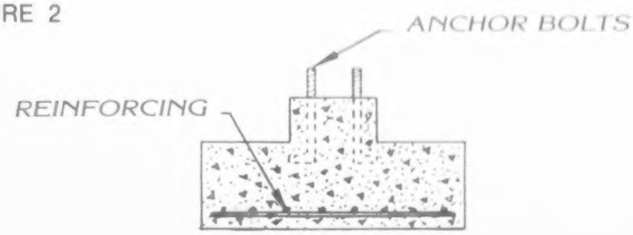

CHAMFER
GRADE
SILL
SILL SEALER
ANCHOR BOLT
PERIMETER INSULATION
REBARS
KEYWAY
FOOTING

INFORMATION SHEET

XIV. Types of concrete footings and foundations (Figures 2-11)

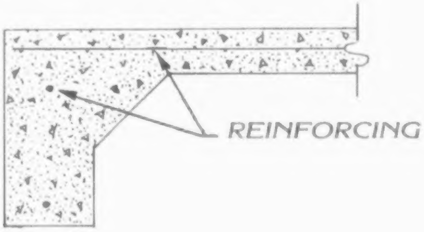
A. Spread footing

FIGURE 2


ANCHOR BOLTS
REINFORCING

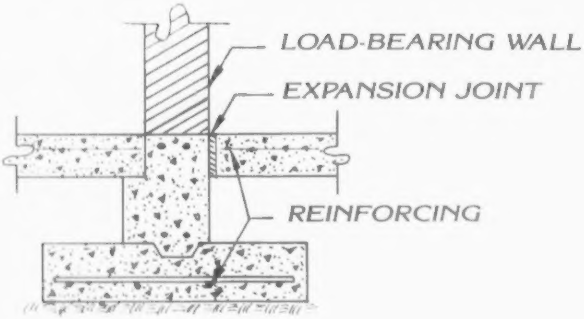
B. Slab on grade (poured monolithic)

FIGURE 3


REINFORCING

C. Bearing-wall footing

FIGURE 4

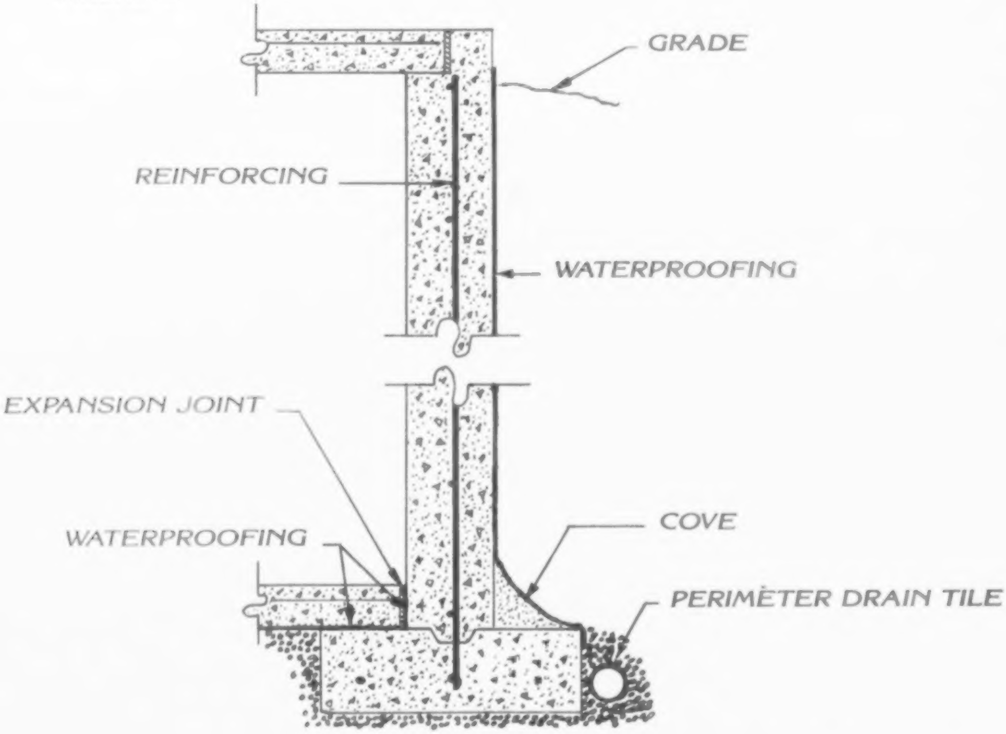

LOAD-BEARING WALL
EXPANSION JOINT
REINFORCING

INFORMATION SHEET

D. Basement foundation

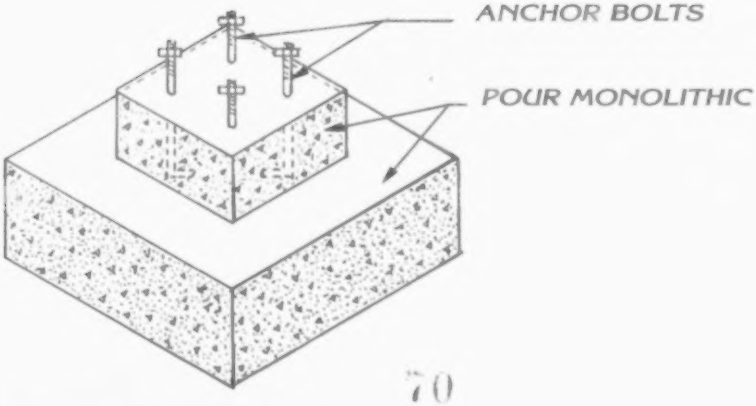
(NOTE: Sometimes it is necessary to use water stops along with keyways or dowels.)

FIGURE 5


GRADE
REINFORCING
WATERPROOFING
EXPANSION JOINT
COVE
WATERPROOFING
PERIMETER DRAIN TILE

E. Pier footing

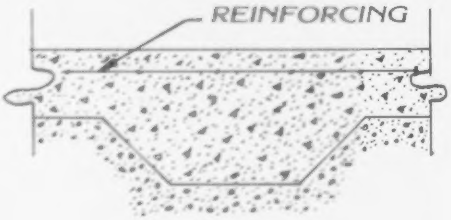
FIGURE 6


ANCHOR BOLTS
POUR MONOLITHIC

INFORMATION SHEET

F. Partition-wall footing

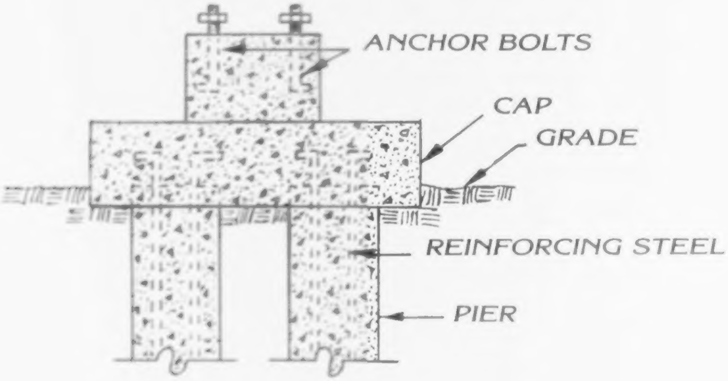
FIGURE 7


REINFORCING

G. Pile or drill pier foundation

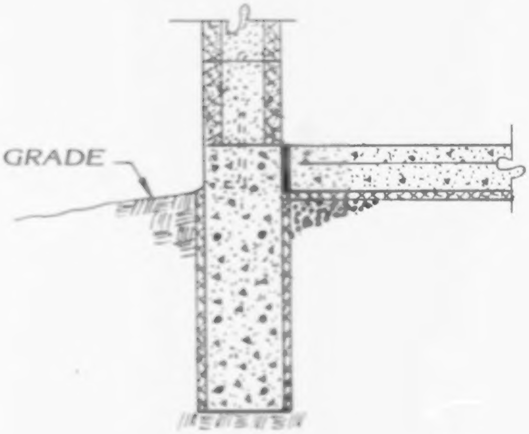
(NOTE: Cap and pier may be poured separately or as a single piece.)

FIGURE 8


ANCHOR BOLTS
CAP
GRADE
REINFORCING STEEL
PIER

H. Grade beam

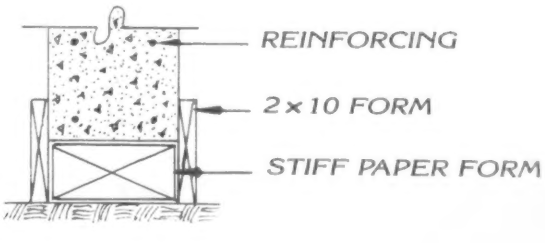
FIGURE 9



INFORMATION SHEET

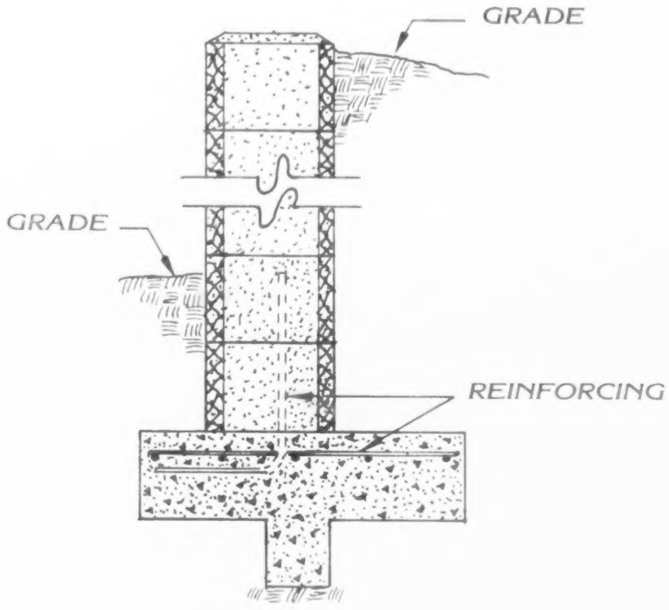
I. Grade beam with collapsible form

FIGURE 10


REINFORCING
2 x 10 FORM
STIFF PAPER FORM

J. Cantilever retaining wall foundation

FIGURE 11


GRADE
GRADE
REINFORCING

XV. Design of footings and foundations

A. Sizes and shapes vary with soil conditions

(NOTE: Some soils provide support or hold water or swell with water. The amount of support from the soil and its reaction to the elements must be considered in selecting the right foundation.)

B. Safe design for width of footing is generally to make it twice as wide as foundation

INFORMATION SHEET

C. Thickness varies with application and climate but is usually eight inches

D. Reinforcing is used where stress is prevalent

EXAMPLES:
1. Stress caused from earthquakes
2. Where footings extend over poor load-bearing material
3. Where footings need to carry extra-heavy loads

E. Depth of footing must be below the frost line

(NOTE: Frost line is the depth to which the soil may freeze. In the United States, frost penetration will vary from ground surface in the far south to five feet, six inches in the far north.)

F. Foundation should extend above finish grade

(NOTE: Finish grade should slope away from the foundation, and the foundation should extend about eight inches above the grade so that wood framing is protected from moisture in the soil.)

XVI. Steps involved in constructing concrete footings and foundations

A. Lay out footings

B. Establish grades for excavating

C. Excavate

D. Establish grades for forms

E. Set forms

F. Fine grade

G. Install reinforcing

H. Calculate concrete

I. Place concrete

J. Vibrate concrete

K. Install keyways and dowel rods

L. Finish surface of concrete

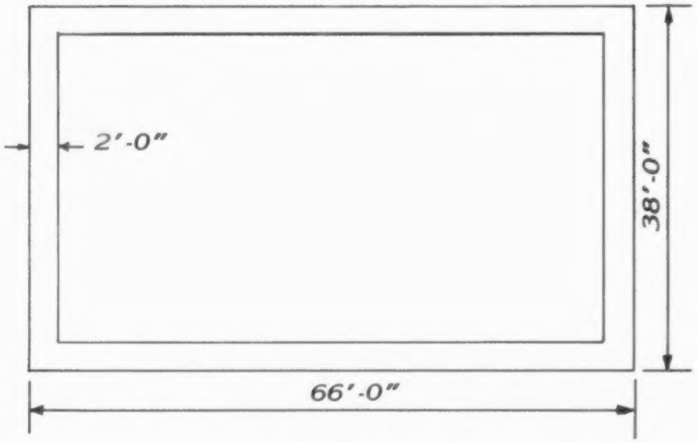
CONCRETE FOUNDATIONS
UNIT I

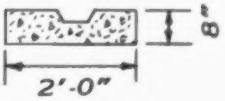
ASSIGNMENT SHEET #1 — ESTIMATE THE AMOUNT OF CONCRETE FOR A FOOTING

NAME ______________________________ SCORE ______________

Accurate measuring and estimating materials are two important skills of the carpenter. These skills take practice, such as this exercise in estimating the amount of concrete required for the footing illustrated below.

Use the dimensions on the drawing and the information sheet to estimate the amount of concrete for the footing. Show your work.





________________ Cubic yards

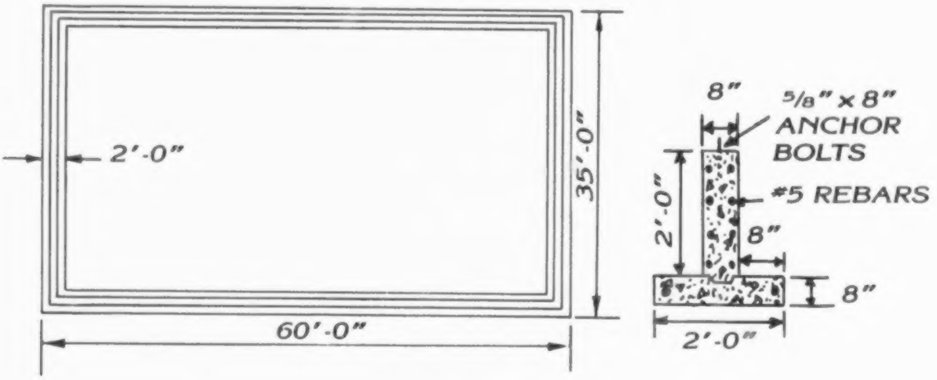
CONCRETE FOUNDATIONS
UNIT I

ASSIGNMENT SHEET #2 — ESTIMATE THE AMOUNT OF MATERIALS TO POUR A FOUNDATION

NAME ______________________________ SCORE ____________

Carpenters must be able to read blueprints to determine material requirements and quantities for construction projects. Most plans provide the necessary information to estimate materials if the carpenter knows how to find it. Often a set of blueprints will contain a sheet showing the design and materials for the foundation, such as in the drawing below.

Use the dimensions on the drawing and the information sheet to estimate the amount of concrete and other materials needed to pour the foundation and footing illustrated.



A. Rebars ____________ Number ____________ Size ____________ Lineal feet

B. Concrete ____________ Cubic yards

C. Anchor bolts ____________ Size ____________ Number

(NOTE: Anchor bolts are set approximately five feet on center.)

CONCRETE FOUNDATIONS
UNIT I

ANSWERS TO ASSIGNMENT SHEETS

Because calculations can vary slightly, the student's work should be evaluated to the satisfaction of the instructor.

Assignment Sheet #1 — Answer should be between $9^{3}/_{4}$ and $10^{1}/_{4}$ cubic yards

Assignment Sheet #2

A. 100 pieces, #5 rebar, 2000 lineal feet

B. 18 to $18^{1}/_{2}$ cubic yards

C. 38 anchor bolts, $^{5}/_{8}$" × 8"

CONCRETE FOUNDATIONS
UNIT I

JOB SHEET #1 — MAKE A SLUMP TEST

I. Tools and materials

A. Wheelbarrow

B. Slump cone mold

C. Bullet-nosed steel rod (smooth) 5/8" by 24"

D. Scoop or trowel

E. Rule

F. Concrete

G. Water in container

II. Procedure

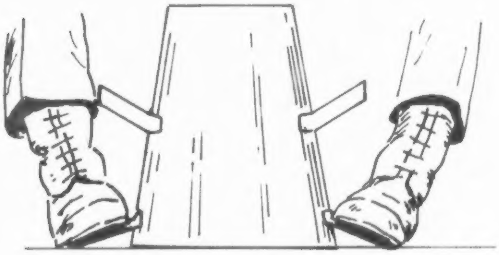
A. Collect concrete in wheelbarrow

B. Dampen slump cone mold with water

C. Place slump cone mold on firm, level, clean, nonabsorbent surface

D. Stand on the foot pieces of cone mold to hold it firmly in place (Figure 12)

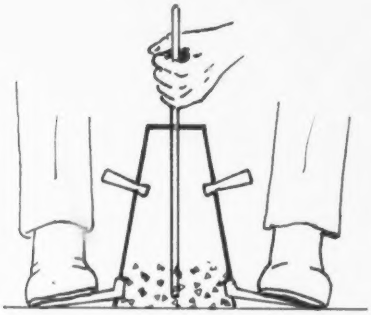
FIGURE 12



JOB SHEET #1

E. Fill one third of cone mold with concrete (Figure 13)

FIGURE 13

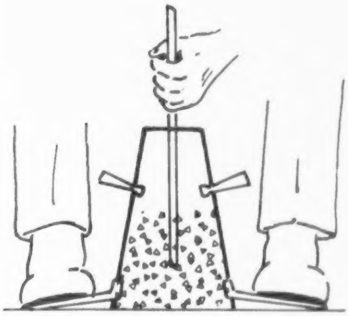


F. Rod with up and down motion twenty-five times, using steel rod

(NOTE: Always distribute rodding strokes evenly by starting at outer edge and moving in a spiral toward center.)

G. Fill two thirds of cone mold with concrete (Figure 14)

FIGURE 14

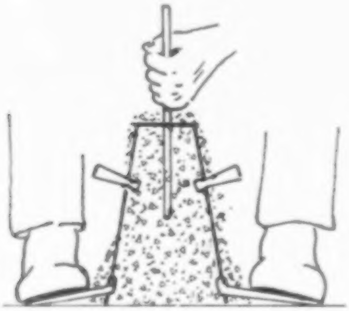


H. Rod twenty-five times, barely penetrating into first layer

JOB SHEET #1

I. Fill cone mold to overflowing with concrete (Figure 15)

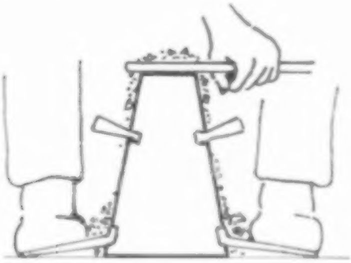
FIGURE 15



J. Again rod twenty-five times, taking same precautions about depth and distribution of strokes

K. Level top of cone with steel rod so that cone mold is level full (Figure 16)

FIGURE 16



L. Clean excess concrete away from base of cone mold

M. Immediately raise cone mold, taking only five to ten seconds to perform this operation

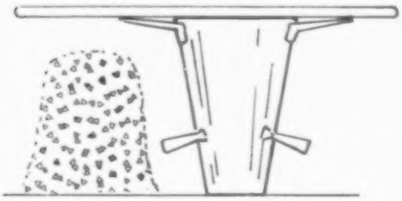
> **CAUTION**
>
> Remove cone mold with a steady upward lift. Do not shake mold in any way or disturb the sample.

N. Place cone mold next to sample upside down, taking care not to disturb sample

JOB SHEET #1

O. Place steel rod horizontally across mold so that it extends over the sample (Figure 17)

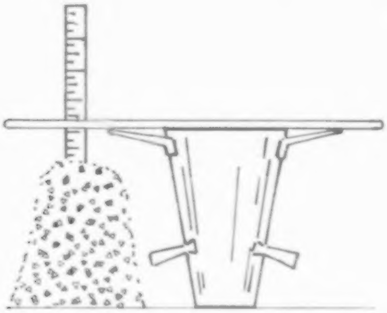
FIGURE 17



P. Measure distance from bottom of steel rod to the point of the original center of sample (Figure 18)

(NOTE: This measurement, to the nearest 1/4 inch, is the slump of the concrete.)

FIGURE 18



Q. Put away equipment and materials and clean work area

CONCRETE FOUNDATIONS
UNIT I

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with concrete foundations to their correct definitions. Write the correct numbers in the blanks provided.

______a. Measure of the consistency of fresh concrete

______b. Projecting beam or member supported at only one end

______c. Continuous mass of concrete cast as a single unit

______d. Ease with which concrete can be placed, consolidated, and finished

______e. Cavity or air pocket in concrete

______f. Substance added to concrete mixture for specific results; added at batch plant

______g. Equipment used to consolidate concrete

______h. Steel bars or mesh embedded in concrete so that the two materials act together in resisting forces

______i. Capable of being penetrated by air or water

______j. Process that occurs when water comes to the surface after concrete has been poured

______k. To join ingredients together into a whole

______l. Any of several materials used for mixing with cement materials to make concrete

______m. Poured, flat area of concrete

______n. Flexible, waterproof material cast in place across a concrete joint to prevent passage of water

1. Monolithic slab
2. Vibrator
3. Honeycomb
4. Permeability
5. Cantilever
6. Admixture
7. Slump
8. Workability
9. Bleeding
10. Reinforcing
11. Water stop
12. Aggregate
13. Slab
14. Consolidate

2. State principal properties of good concrete.

a. ____

TEST

b. ____

c. ____

d. ____

3. State factors that affect properties of concrete mixture.

a. ____

b. ____

c. ____

d. ____

4. Discuss differences between rich mix and lean mix.

a. Rich mix

1) ____

2) ____

b. Lean mix

1) ____

2) ____

5. Match types of admixtures to their functions. Write the correct numbers in the blanks.

______a. Agent that speeds the setting of concrete

______b. Agent that helps to seal concrete against water penetration

______c. Agent that increases the fluidity of concrete

______d. Agent that delays setting of concrete

______e. Agent used to achieve a desired color

______f. Agent used to improve workability and quality of concrete and to lower cost

______g. Agent that incorporates microscopic air bubbles into concrete to improve workability and durability

1. Water reducer
2. Pozzolan
3. Accelerator
4. Retarder
5. Air-entraining admixture
6. Waterproofer
7. Color pigment

TEST

6. State five benefits of admixtures in concrete.

a. ____

b. ____

c. ____

d. ____

e. ____

7. State two reasons for using vibrators in concrete.

a. ____

b. ____

8. Select from the following list types of vibrators used to consolidate concrete. Write an "X" in the blank before each correct answer.

_____a. Air or pneumatic

_____b. Lightweight electric immersion-type

_____c. Exterior immersion-type

_____d. Medium-duty gasoline

_____e. Heavy-duty electric immersion-type

9. Write the formula for estimating concrete.

10. Name types of reinforcing used in concrete.

a. ____

b. ____

TEST

11. Match common rebar numbers to their correct diameter sizes. Write the correct sizes in the blanks.

_______________ a. #5
_______________ b. #11
_______________ c. #8
_______________ d. #6
_______________ e. #14
_______________ f. #10
_______________ g. #7
_______________ h. #3
_______________ i. #18
_______________ j. #4
_______________ k. #9

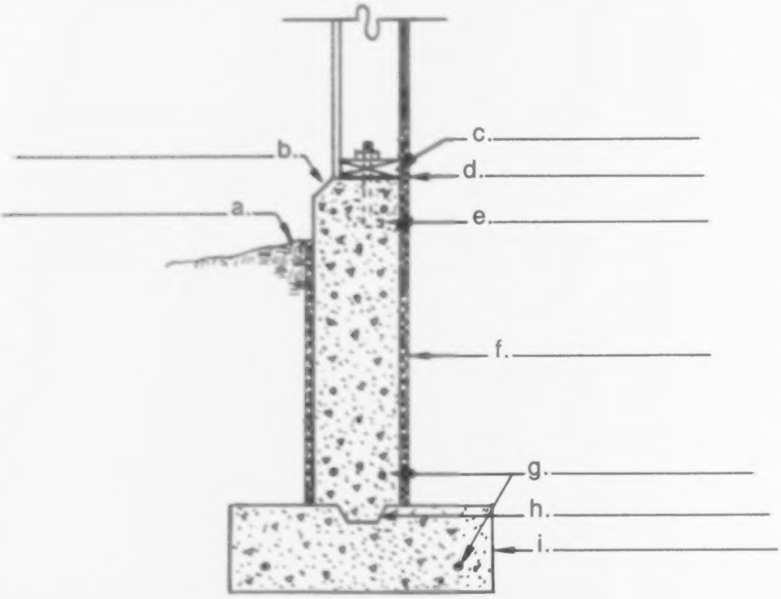
1¼" diameter
⅞" diameter
⅜" diameter
2¼" diameter
1¾" diameter
¾" diameter
1⅜" diameter
⅝" diameter
½" diameter
1⅛" diameter
1" diameter

12. Select from the following list common sizes of welded wire fabric. Write an "X" in the blank before each correct answer.

_______________ a. 3/3 × 14/14
_______________ b. 6/6 × 16/16
_______________ c. 4/4 × 10/10
_______________ d. 4/4 × 2/2
_______________ e. 8/8 × 6/6
_______________ f. 2/2 × 16/16
_______________ g. 6/6 × 4/4
_______________ h. 6/6 × 16/16
_______________ i. 4/4 × 4/4
_______________ j. 6/6 × 6/6
_______________ k. 2/2 × 2/2
_______________ l. 6/6 × 10/10

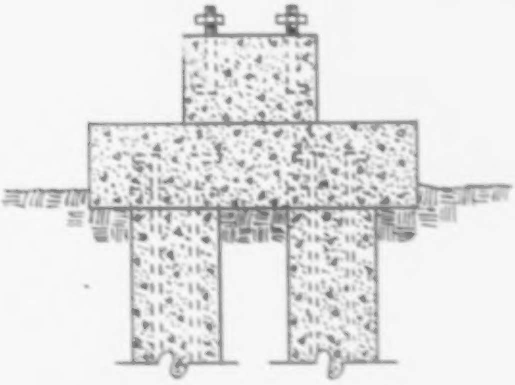
TEST

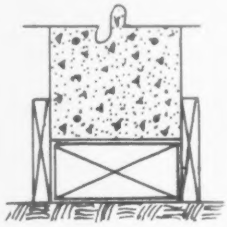
13. Label parts of the concrete foundation illustrated. Write the correct names in the blanks.



14. Identify types of concrete footings and foundations illustrated. Write the correct names in the blanks.

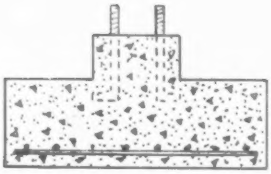
Partition-wall footing
Grade beam
Cantilever retaining wall foundation
Basement foundation
Slab on grade (poured monolithic)
Grade beam with collapsible form
Bearing-wall footing
Spread footing
Pier footing
Pile or drill pier foundation



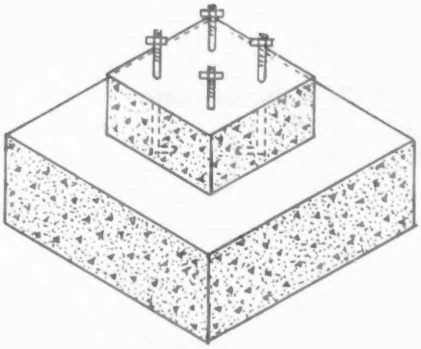


a. ____________________ b. ____________________

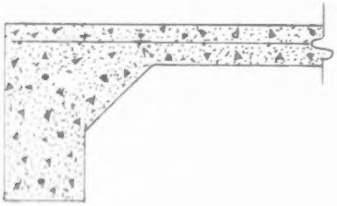
TEST



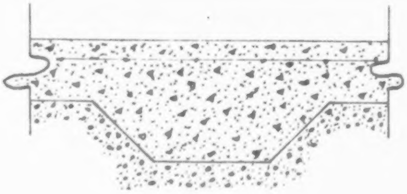
c. ______________________________



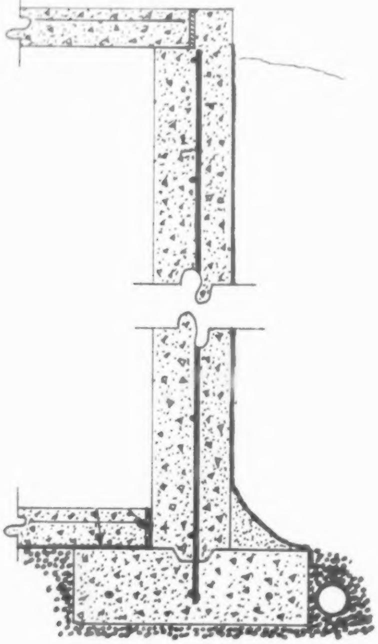
d. ______________________________



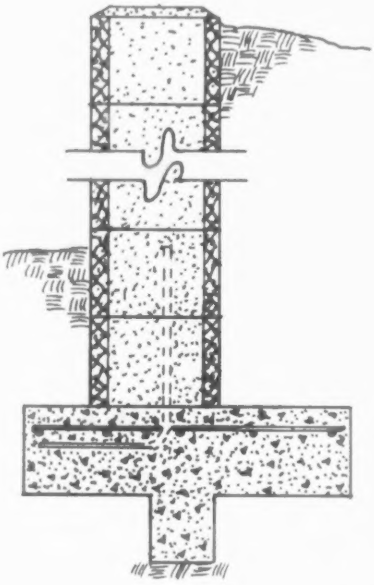
e. ______________________________



f. ______________________________

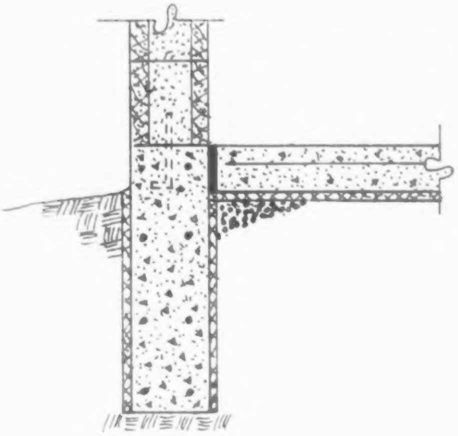


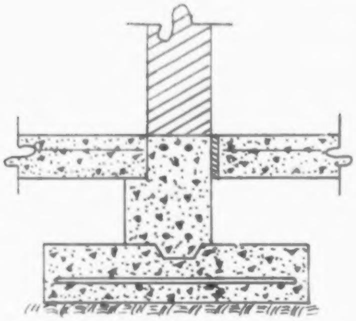
g. ______________________________



h. ______________________________

TEST





i. ______________________ j. ______________________

15. Discuss design of footings and foundations. Mention at least five considerations in the size, shape, reinforcement, and placement of footings and foundations.

16. List the steps involved in constructing concrete footings and foundations.

a.

b.

c.

d.

e.

f.

g.

TEST

h. ______________________________

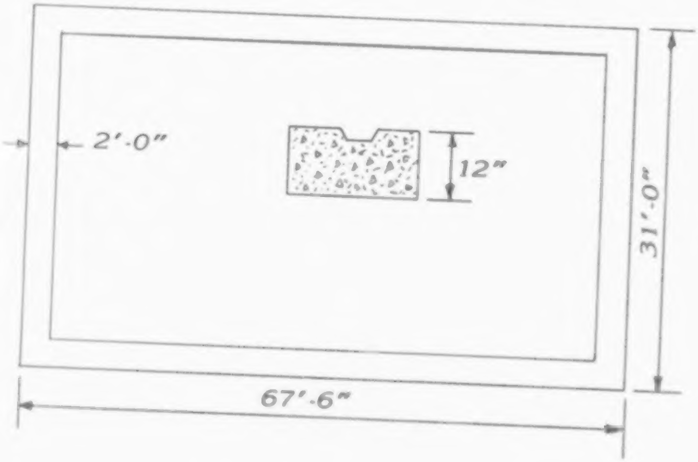
i. ______________________________

j. ______________________________

k. ______________________________

l. ______________________________

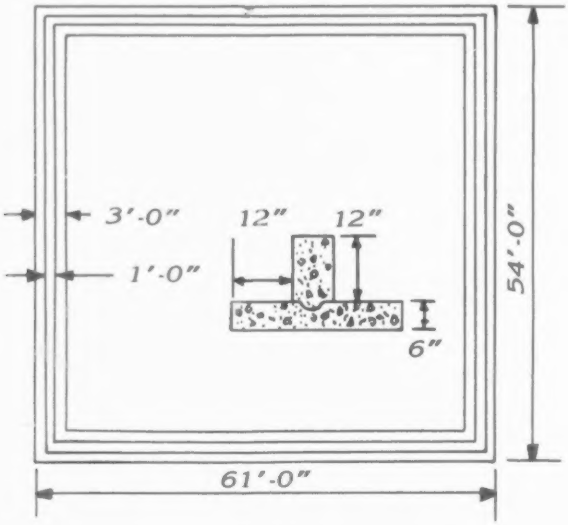
17. Estimate amount of concrete for the footing illustrated below.


2'-0"
12"
31'-0"
67'-6"

______________ Cubic yards

TEST

18. Estimate amount of materials to pour the foundation illustrated below.



a. Rebars ________________ Number ________________ Lineal feet

b. Concrete ________________ Cubic yards

(NOTE: Test question 19 is a job sheet. It is an important part of this test. If it has not been completed, check with your instructor.)

19. Demonstrate the ability to make a slump test.

CONCRETE FOUNDATIONS
UNIT I

ANSWERS TO TEST

1. a. 7
   b. 5
   c. 1
   d. 8
   e. 3
   f. 6
   g. 2
   h. 10
   i. 4
   j. 9
   k. 14
   l. 12
   m. 13
   n. 11

2. a. Workability
   b. Durability
   c. Strength
   d. Economy

3. a. Air content
   b. Water/cement ratio
   c. Range of slump
   d. Maximum size of aggregate

4. a. Rich mix
      1) More cement and water
      2) Less coarse aggregate
   b. Lean mix
      1) Less cement and water
      2) More coarse aggregate

5. a. 3
   b. 6
   c. 1
   d. 4
   e. 7
   f. 2
   g. 5

6. Answer should include any five of the following
   a. Increased durability
   b. Improved resistance to effects from freezing and thawing
   c. Controlled setting time
   d. Increased early strength
   e. Enhanced appearance
   f. Improved workability
   g. Less heat generation
   h. Lower cost

7. Answer should include any two of the following
   a. Consolidate concrete into a dense mass
   b. Prevent honeycombing
   c. Produce a smooth surface along the forms
   d. Consolidate concrete around reinforcing and inserts

ANSWERS TO TEST

8. a, b, d, e

9. $$\frac{\text{Width in Feet} \times \text{Length in Feet} \times \text{Thickness in Feet}}{\text{27 Cubic Feet per Cubic Yard}} = \text{Cubic Yards of Concrete}$$

10. a. Reinforcing bars or rebars
    b. Welded wire fabric or wire mesh

11. a. 5/8″ diameter
    b. 1 3/8″ diameter
    c. 1″ diameter
    d. 3/4″ diameter
    e. 1 3/4″ diameter
    f. 1 1/4″ diameter
    g. 7/8″ diameter
    h. 3/8″ diameter
    i. 2 1/4″ diameter
    j. 1/2″ diameter
    k. 1 1/8″ diameter

12. c, f, g, i, j, l

13. a. Grade
    b. Chamfer
    c. Sill
    d. Sill sealer
    e. Anchor bolt
    f. Perimeter insulation
    g. Rebars
    h. Keyway
    i. Footing

14. a. Pile or drill pier foundation
    b. Grade beam with collapsible form
    c. Spread footing
    d. Pier footing
    e. Slab on grade (poured monolithic)
    f. Partition-wall footing
    g. Basement foundation
    h. Cantilever retaining wall foundation
    i. Grade beam
    j. Bearing-wall footing

15. Discussion should include any five of the following
    a. Sizes and shapes vary with soil conditions
    b. Safe design for width of footing is generally to make it twice as wide as foundation
    c. Thickness varies with application and climate but is usually eight inches
    d. Reinforcing is used where stress is prevalent
    e. Depth of footing must be below the frost line
    f. Foundation should extend above finish grade

ANSWERS TO TEST

16. a. Lay out footings
    b. Establish grades for excavating
    c. Excavate
    d. Establish grades for forms
    e. Set forms
    f. Fine grade
    g. Install reinforcing
    h. Calculate concrete
    i. Place concrete
    j. Vibrate concrete
    k. Install keyway and dowel rods
    l. Finish surface of concrete

(NOTE: Since answers for 17 and 18 may vary slightly, they should be evaluated to the satisfaction of the instructor.)

17. 14 to $14\frac{3}{4}$ cubic yards

18. a. Rebars — 72 pieces or 1440 lineal feet
    b. Concrete — $20\frac{1}{4}$ to 21 cubic yards

19. Performance skill evaluated to the satisfaction of the instructor

WOOD FOUNDATIONS
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to identify types of wood foundations, identify parts of a wood-foundation system, and construct a wood-foundation wall. The student will show this knowledge by completing the job sheet and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with wood foundations to their correct definitions.
2. Identify parts of a wood-foundation system.
3. Label types of wood foundations.
4. State methods used to construct wood foundations.
5. State benefits of using wood-foundation systems.
6. Demonstrate the ability to install a crawl-space foundation wall.

WOOD FOUNDATIONS
UNIT II

SUGGESTED ACTIVITIES

I. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Job Sheet #1 — Install a Crawl-Space Foundation Wall

   E. Test

   F. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

   B. Obtain materials to supplement unit.

      1. Additional resources

         (NOTE: See Section IV of Suggested Activities.)

      2. Competency profiles

         (NOTE: Competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

      3. Model of a wood-foundation system

   C. Introduce unit.

   SUGGESTIONS:

   - Survey local builders and suppliers to gain some idea of how extensively wood-foundation systems are being used in your area.
   - Invite representatives from manufacturers and distributors of wood-foundation components to speak to the class.
   - Share with the class literature or samples of wood-foundation components.

SUGGESTED ACTIVITIES

D. Provide students with objective sheet.

E. Discuss objective sheet, relating objectives to your introduction of the unit.

F. Provide students with information sheet.

G. Discuss information sheet.

1. Use Information Sheet, Section I to discuss terms associated with wood foundations.

   SUGGESTIONS:

   - Have samples of materials for applicable terms.
   - Use a model of a wood foundation to discuss terms and to introduce the next objective.

2. Use Information Sheet, Section II to discuss parts of a wood-foundation system, emphasizing that design of the system is affected by building site and applicable codes.

   SUGGESTIONS:

   - Build a model of the wood-foundation system illustrated in the information sheet. Allow students to study the model and to disassemble and reassemble it if possible.
   - Provide samples of hardware used in wood foundations and discuss the special treatment required.
   - Have students compare wood-foundation parts to concrete-foundation parts and to examine reasons for the similarities and differences.

3. Use Information Sheet, Section III to discuss types of wood foundations.

   SUGGESTIONS:

   - Tour construction sites where wood foundations are being used.
   - Discuss reasons for differences in the types of wood foundations.
   - Review local building codes that are applicable to wood foundations.

4. Use Information Sheet, Section IV to discuss methods used to construct wood foundations.

SUGGESTED ACTIVITIES

SUGGESTIONS:

- Visit locations to see each method of construction.
- Have builders talk to the class about advantages and disadvantages of each method, including material costs, labor, and handling.
- Discuss modifications of these methods, such as foundation panels that come with or without footing plates.

5. Use Information Sheet, Section V to discuss benefits of using wood-foundation systems.

SUGGESTIONS:

- Have students discuss the benefits of wood foundations that are listed in the information sheet, and have them try to list other benefits.
- Have students compare building a specific house at a given location using a wood versus a concrete foundation to determine actual benefits realized and not realized.

H. Provide students with job sheet.

I. Discuss and demonstrate the procedures outlined in Job Sheet #1, emphasizing safety in handling panels, power tools, and chemicals.

SUGGESTIONS:

- Demonstrate the procedure in a controlled environment at the training facility if possible.

  (NOTE: If a construction project with wood foundations is not practical in your program, you may wish to use an excavation ditch at the training facility to allow students to practice wood-foundation construction.)

- Stress special considerations for soil conditions, high winds, and other influences.
- Emphasize measures that are taken to protect and seal the foundation, such as caulking, preservative treatment, and vapor barriers.
- Point out the importance of a solid footing and adequate bracing.

J. Have students complete Job Sheet #1.

K. Give test.

SUGGESTED ACTIVITIES

L. Critique test and discuss in class.

M. Reteach if necessary.

N. Complete appropriate section of competency profiles.

III. Reference — *All-Weather Wood Foundation System: Design Fabrication Installation Manual.* Washington, D.C.: National Forest Products Association, 1982.

IV. Additional resources

A. *All-Weather Wood Foundations* — Available from American Plywood Association, P.O. Box 11700, Tacoma, Washington 98411.

B. *All-Weather Wood Foundation System* — Available from National Forest Products Association, 1619 Massachusetts Avenue, N.W., Washington, D.C. 20036.

C. *Timber Construction Manual* — Available from American Institute of Timber Construction, 333 W. Hampden Avenue, Englewood, Colorado 80110.

D. *Western Woods Use Book* — Available from Western Wood Products Association, 1500 S.W. Taylor, Portland, Oregon 97205.

E. *Wood Engineering* by Dr. G. Garfinkel — Available from Southern Forest Products Association, P.O. Box 52468, New Orleans, Louisiana 70152.

WOOD FOUNDATIONS
UNIT II

INFORMATION SHEET

I. Terms and definitions associated with wood foundations

   A. Wood-foundation system — Below-grade stud wall built of pressure- and preservative-treated lumber and plywood; used as a foundation for light-frame construction

   B. Wood-preservative treatment — Process of putting special salts into wood as specified in the American Wood Preservers Bureau's standards

   C. Wood preservative — Substance used to protect wood against decay and insects

   D. Prefabricated unit — Building component constructed at a shop and delivered ready to be erected at job site

   E. Knee wall — Stud wall used to support brick veneer on foundation footing plate

   F. Backfill — To refill ditch or excavation adjacent to foundation

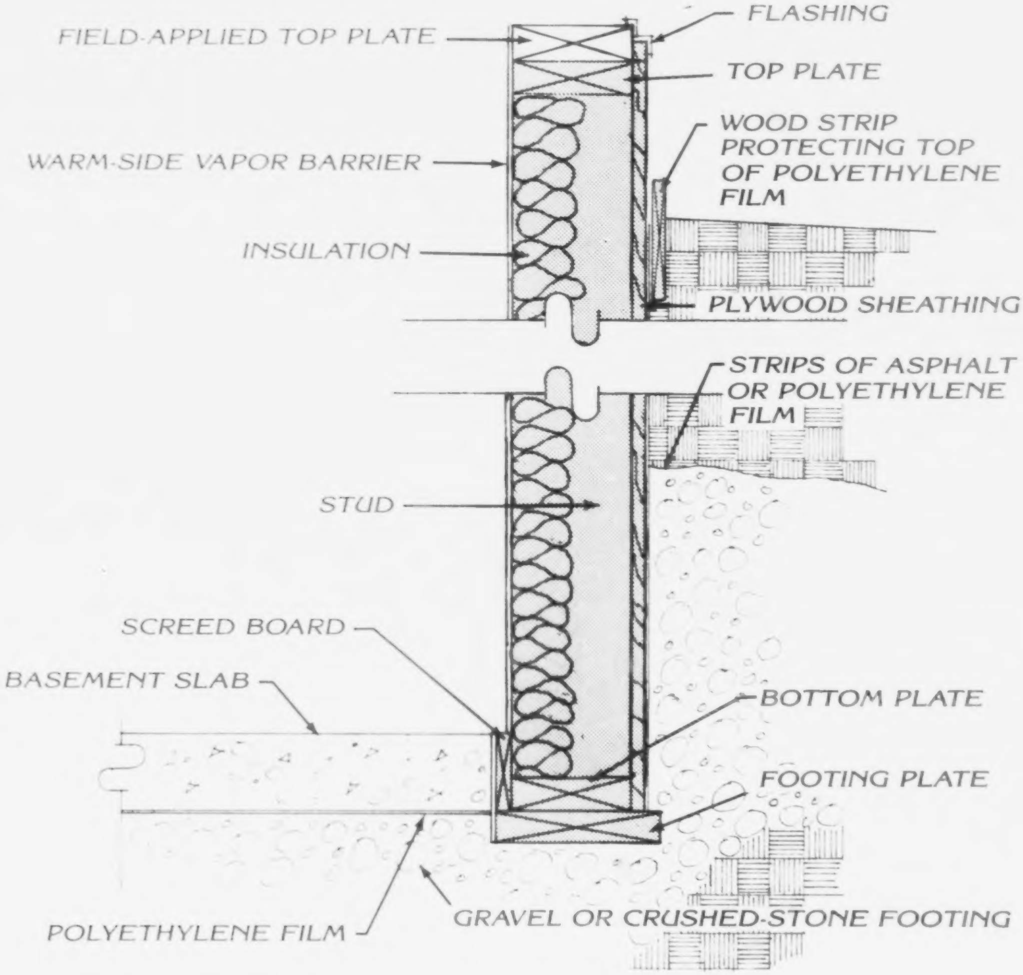
   G. Caulk — To apply a pliable substance that forms a weathertight seal

   H. Polyethylene film — Any of various lightweight plastic materials that are resistant to chemicals and moisture and have good insulating properties

INFORMATION SHEET

II. Parts of a wood-foundation system (Figure 1)

FIGURE 1



FIELD-APPLIED TOP PLATE
FLASHING
TOP PLATE
WOOD STRIP PROTECTING TOP OF POLYETHYLENE FILM
WARM-SIDE VAPOR BARRIER
INSULATION
PLYWOOD SHEATHING
STRIPS OF ASPHALT OR POLYETHYLENE FILM
STUD
SCREED BOARD
BASEMENT SLAB
BOTTOM PLATE
FOOTING PLATE
POLYETHYLENE FILM
GRAVEL OR CRUSHED-STONE FOOTING

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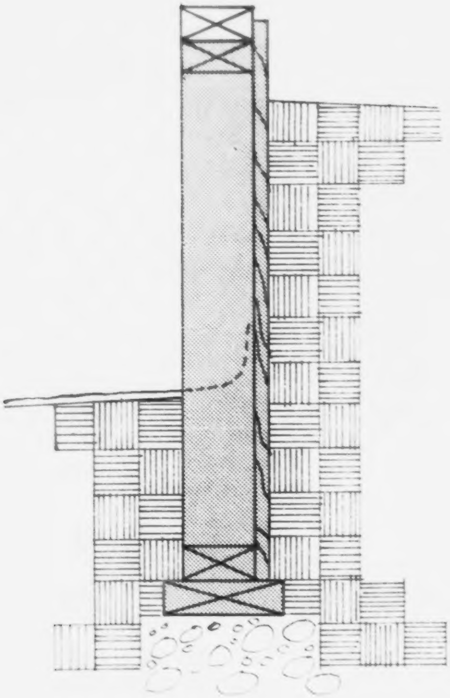
INFORMATION SHEET

III. Types of wood foundations (Figures 2-9)

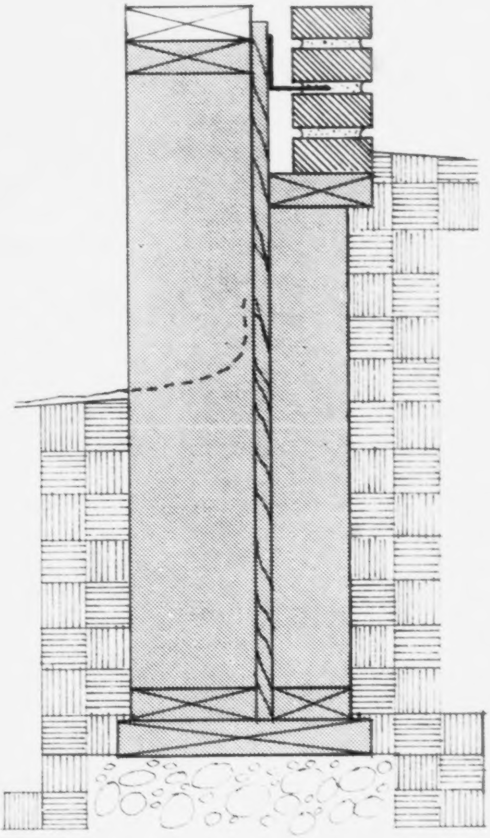
A. Crawl space

FIGURE 2



B. Crawl space with brick veneer on knee wall

FIGURE 3

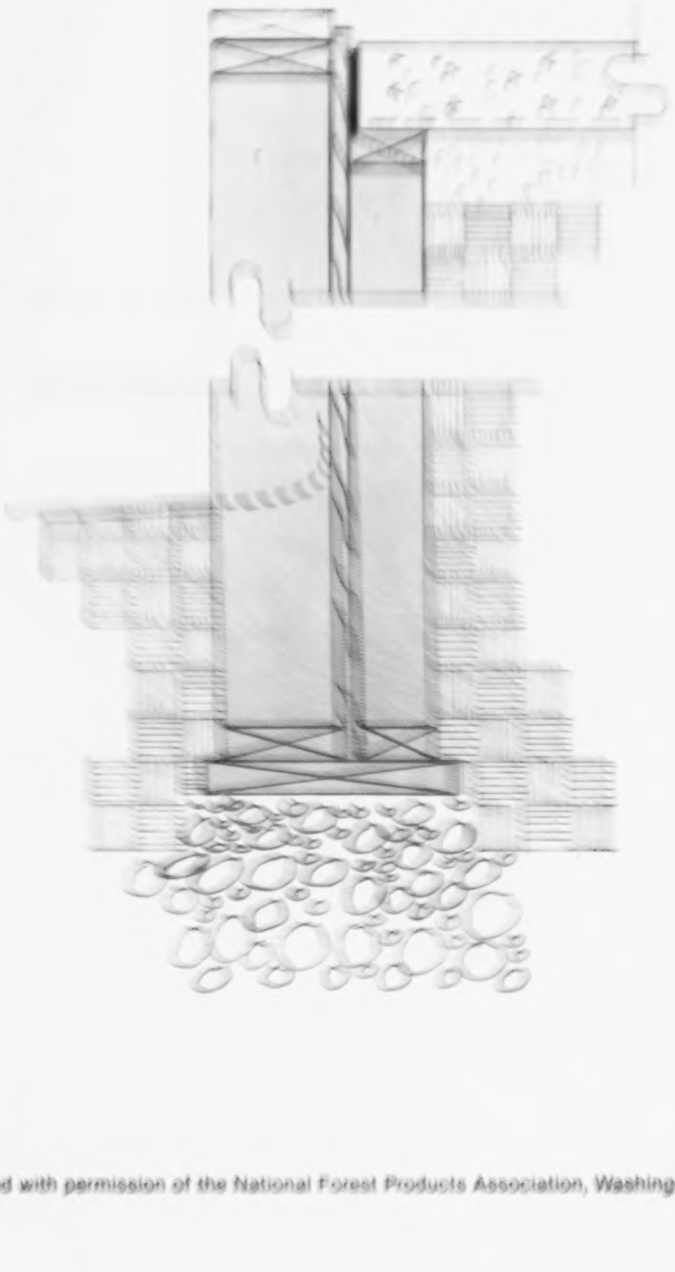


Figures 2 and 3 adapted with permission of the National Forest Products Association, Washington, D.C.

INFORMATION SHEET

C. Crawl space with porch knee wall

FIGURE 4



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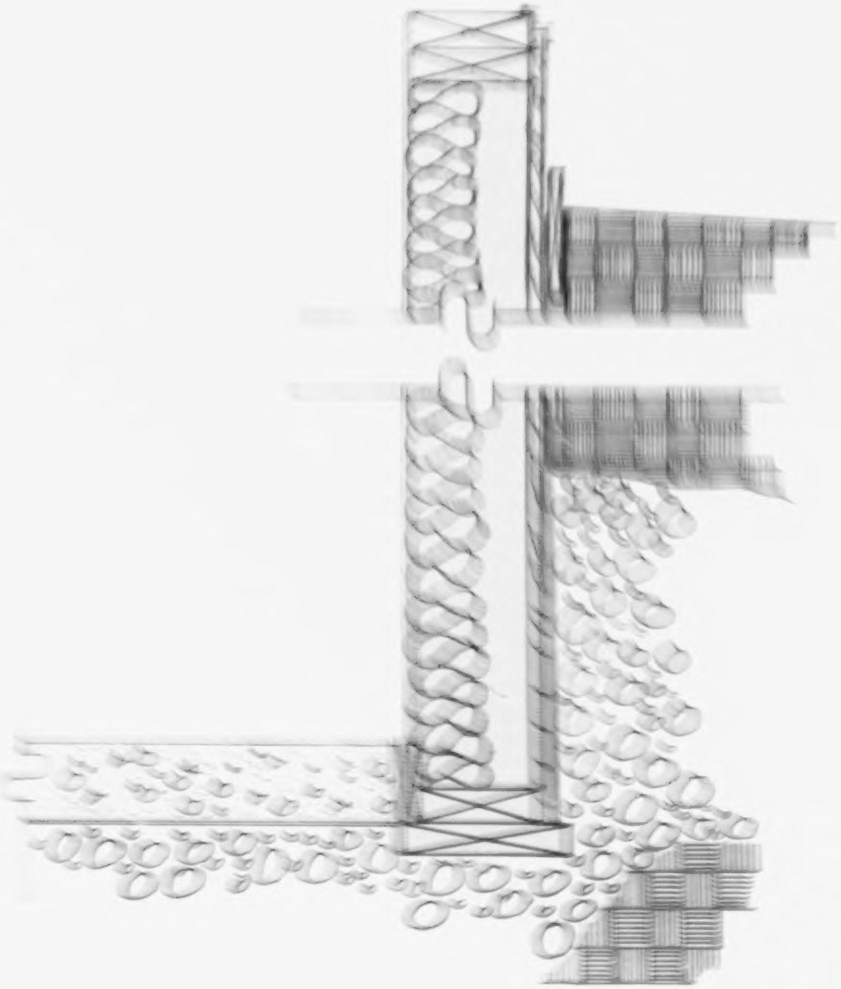
INFORMATION SHEET

D. Basement

FIGURE 5



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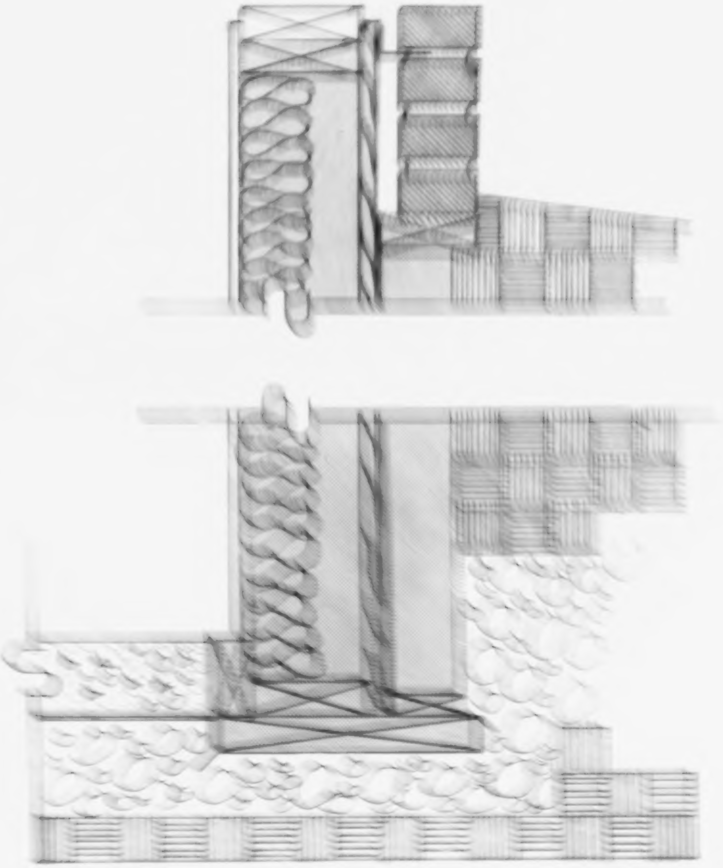
INFORMATION SHEET

E. Basement with brick veneer on knee wall

FIGURE 6



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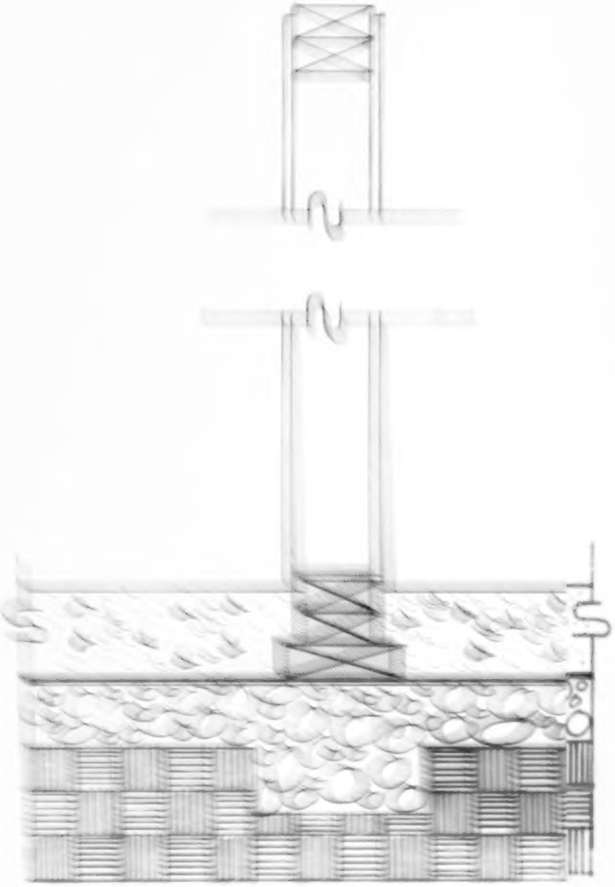
INFORMATION SHEET

F. Basement bearing partition

FIGURE 7



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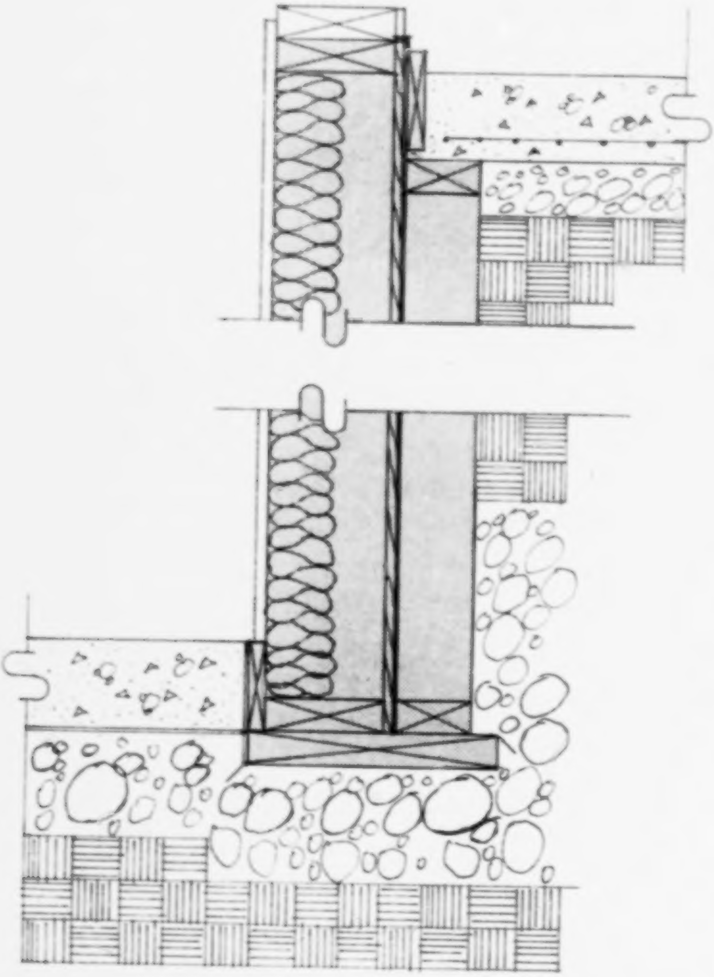
INFORMATION SHEET

G. Basement with knee wall supporting garage or porch floor

FIGURE 8



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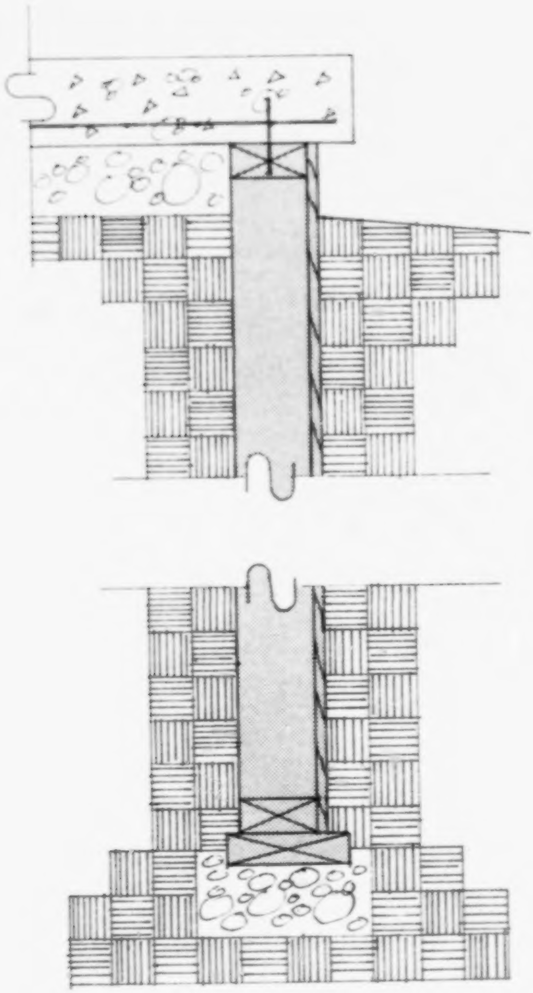
INFORMATION SHEET

H. Wall supporting porch floor

FIGURE 9



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INFORMATION SHEET

IV. Methods used to construct wood foundations

- A. Fabricated on site
- B. Prefabricated
- C. Built in place

V. Benefits of using wood-foundation systems

- A. Accurate scheduling
- B. Fast installation
- C. Installation in almost any type of weather
- D. Energy savings
- E. Easy finishing
- F. Economy

WOOD FOUNDATIONS
UNIT II

JOB SHEET #1 — INSTALL A CRAWL-SPACE FOUNDATION WALL

I. Tools, equipment, and materials

- A. String line
- B. Two plumb bobs
- C. Carpenter's level
- D. Claw hammer
- E. Sledgehammer
- F. Handsaw
- G. Power handsaw
- H. Rule or tape
- I. Caulking gun
- J. Small paint brush
- K. Gravel, sand, or crushed-stone footing
- L. Prefabricated, preservative-treated wall panels
- M. Panel-setting diagrams provided by manufacturer
- N. Specifications
- O. Two 4×4s, 8 to 12 feet long
- P. Two 2×4 gauge blocks
- Q. 1×4s for bracing
- R. 2×4 stakes for bracing
- S. 2×6s for top plates
- T. Caulking
- U. 8d, 16d, and 20d nails, anchor straps, and connector plates

  (NOTE: Use rust-resistant nails and fasteners according to specifications.)
- V. Wood preservative for use on lumber where cuts are made

JOB SHEET #1

II. Procedure

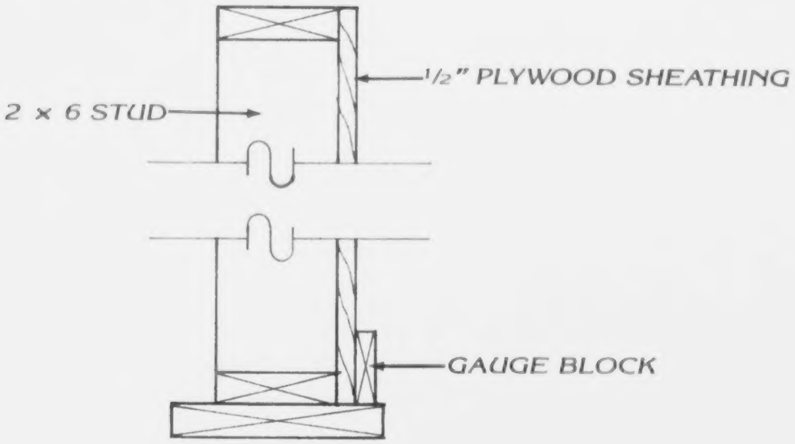
(NOTE: Prior to beginning this procedure, a foundation ditch must be excavated to permit panel installation.)

A. Fill foundation ditch with gravel to height required by panel manufacturer and local codes

B. Place one end of each 4×4 in ditch and lean other end against top of ditch

C. Nail gauge block to each end of panel at bottom and outside of sheathing (Figure 10)

FIGURE 10



D. Set panel on 4×4s and slide panel into ditch

E. Attach string line to batter boards on mark that represents panel line plus 1½ inches to allow for gauge block

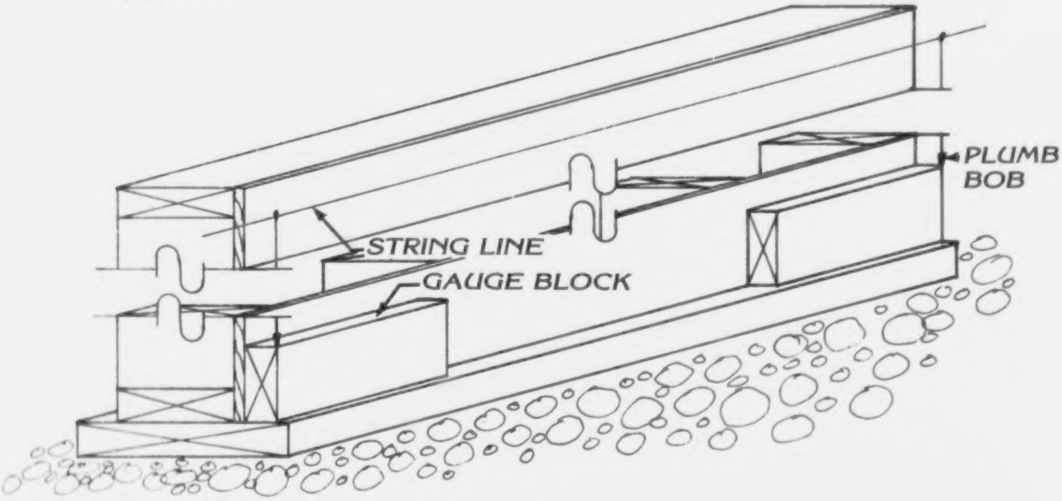
F. Attach plumb bobs to line so that they will correspond with each end of panel

G. Refer to panel-setting diagrams provided by manufacturer and align panel to the line so that it will be positioned properly to the corner

H. Align panel so that outer edge of gauge block is directly under the points of the plumb bobs (See Figure 11)

JOB SHEET #1

FIGURE 11



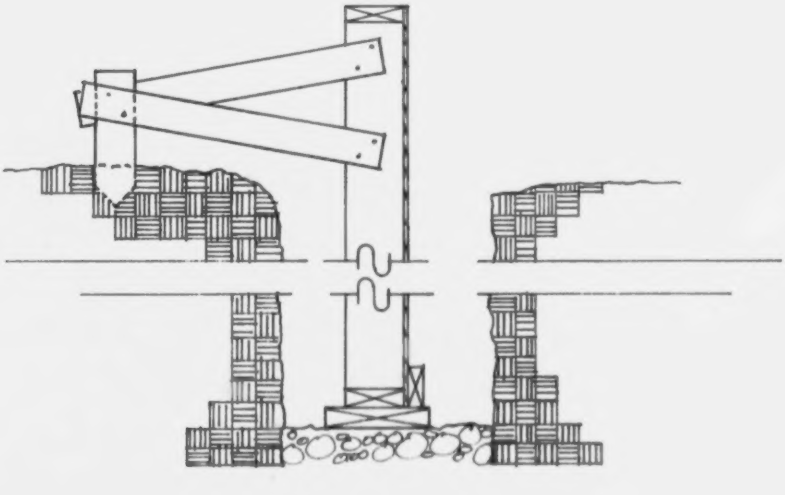
STRING LINE
GAUGE BLOCK
PLUMB BOB

I. Use carpenter's level to plumb the panel

J. Brace panel (Figure 12)

(NOTE: It is necessary to brace panel in place until other corner panel is set. Once other corner is set and the two nailed together, they will be stable.)

FIGURE 12



JOB SHEET #1

K. Check distance between string line and sheathing

(NOTE: This distance should be the same as the thickness of the gauge block.)

L. Remove gauge blocks

M. Frame corner panels, using conventional framing procedures

N. Continue to set all the panels, following the procedures in steps C through M

O. Caulk all adjacent panels

(NOTE: Be sure all joints are sealed.)

P. After all panels are set, check foundation for squareness

Q. Recheck to see that all panels are plumb

R. Use sufficient bracing to resist wind and make wall safe for carpenters to work on

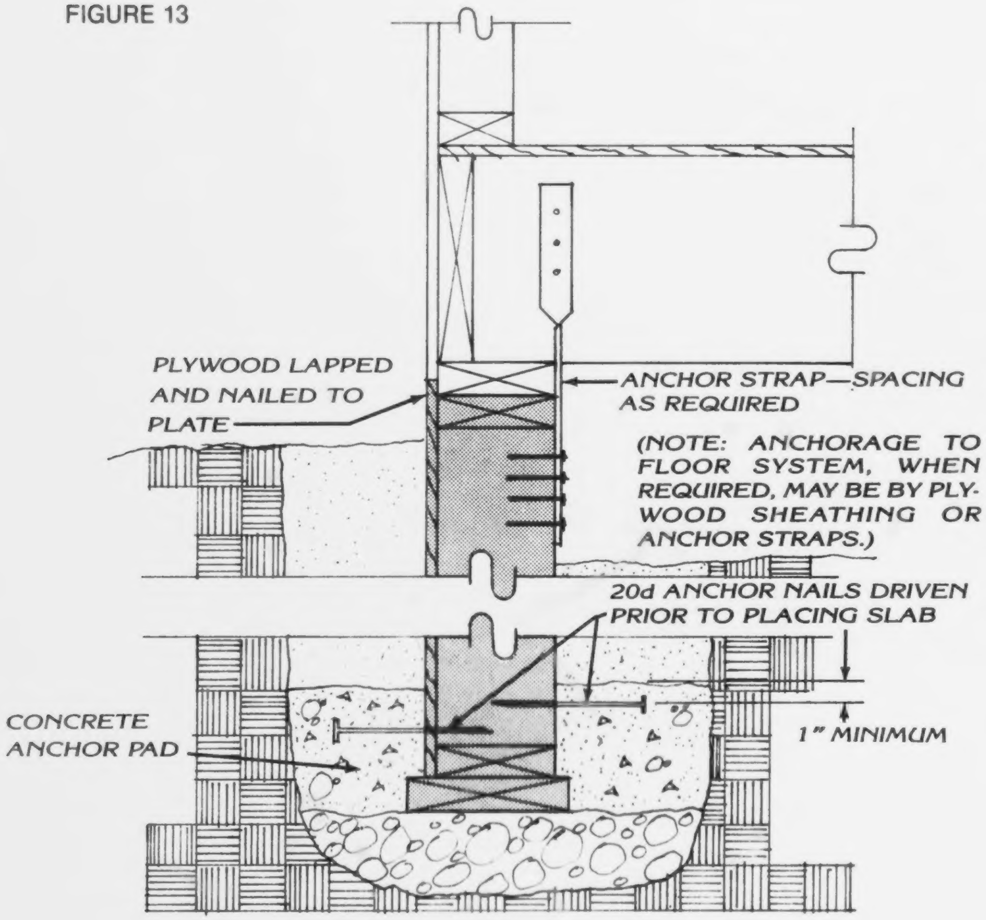
S. Install field-applied top plate

(NOTE: Do not place field-applied top-plate joints directly above wall-panel joints.)

T. Where high winds are prevalent, anchor studs to a concrete anchor slab or as required by structural analysis (See Figure 13)

JOB SHEET #1

FIGURE 13


PLYWOOD LAPPED AND NAILED TO PLATE
ANCHOR STRAP—SPACING AS REQUIRED
(NOTE: ANCHORAGE TO FLOOR SYSTEM, WHEN REQUIRED, MAY BE BY PLYWOOD SHEATHING OR ANCHOR STRAPS.)
20d ANCHOR NAILS DRIVEN PRIOR TO PLACING SLAB
CONCRETE ANCHOR PAD
1" MINIMUM

Adapted with permission of the National Forest Products Association, Washington, D.C.

U. Backfill inside and outside with good clean soil

(NOTE: Some water precautions may be necessary due to local conditions.)

V. After trench is partially filled and compacted, remove lower braces

W. Complete backfilling

X. Clean up area and put away tools and equipment

WOOD FOUNDATIONS
UNIT II

TEST

NAME ______________________________ SCORE ____________

1. Match terms associated with wood foundations to their correct definitions. Write the correct numbers in the blanks.

_____a. To apply a pliable substance that forms a weathertight seal

_____b. Stud wall used to support brick veneer on foundation footing plate

_____c. Substance used to protect wood against decay and insects

_____d. To refill ditch or excavation adjacent to foundation

_____e. Any of various lightweight plastic materials that are resistant to chemicals and moisture and have good insulating properties

_____f. Process of putting special salts into wood as specified in the American Wood Preservers Bureau's standards

_____g. Building component constructed at a shop and delivered ready to be erected at job site

_____h. Below-grade stud wall built of pressure- and preservative-treated lumber and plywood; used as a foundation for light-frame construction

1. Wood preservative
2. Wood-foundation system
3. Wood-preservative treatment
4. Caulk
5. Backfill
6. Knee wall
7. Prefabricated unit
8. Polyethylene film

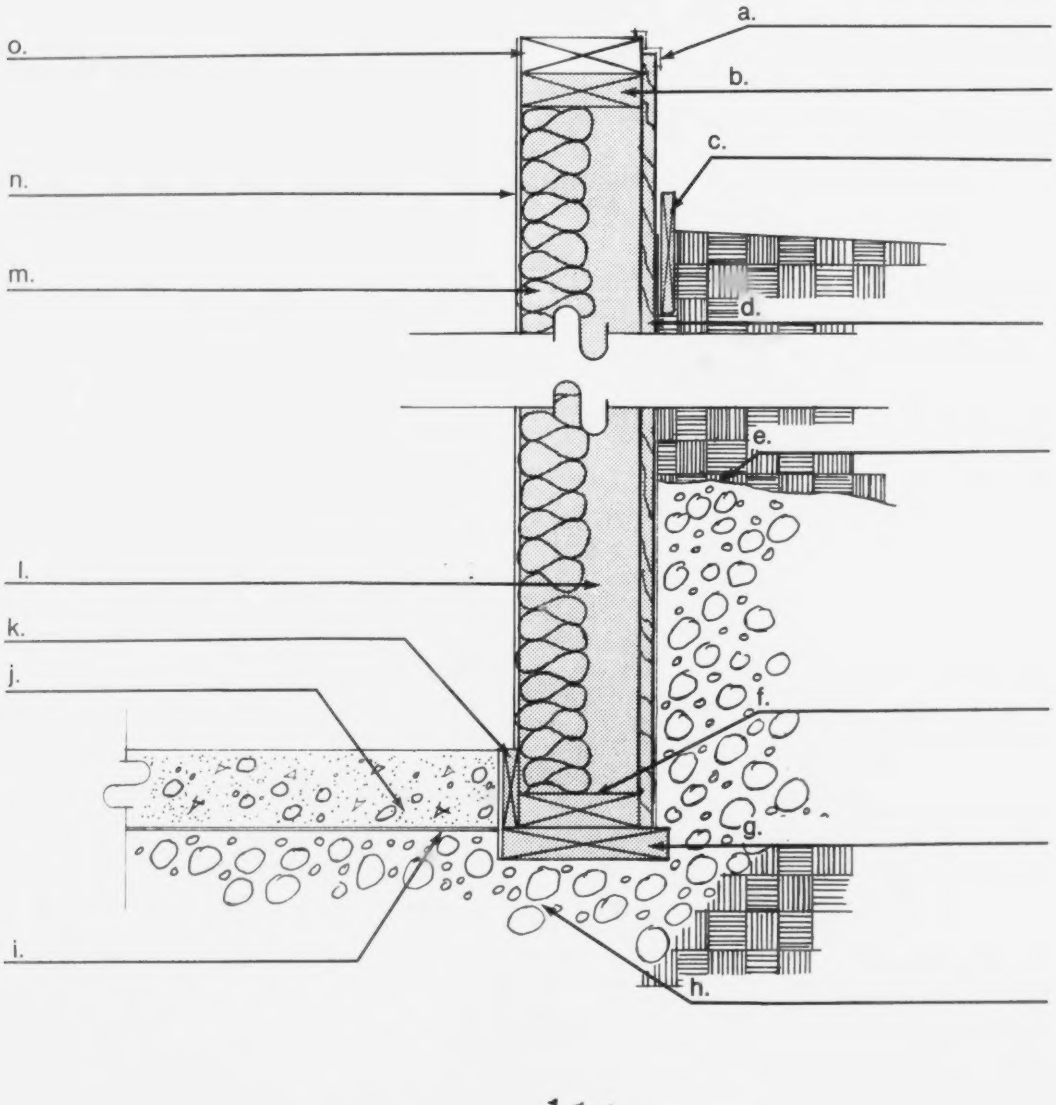
TEST

2. Identify the parts of the wood-foundation system illustrated below. Write the correct names in the blanks.

Field-applied top plate
Polyethylene film
Plywood sheathing
Footing plate
Screed board
Top plate

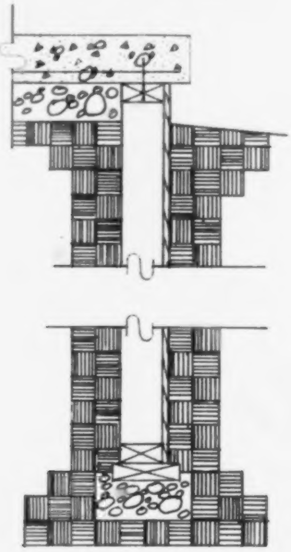
Wood strip protecting top of polyethylene film
Gravel or crushed-stone footing
Warm-side vapor barrier
Strips of asphalt or polyethylene film
Basement slab

Bottom plate
Stud
Flashing
Insulation



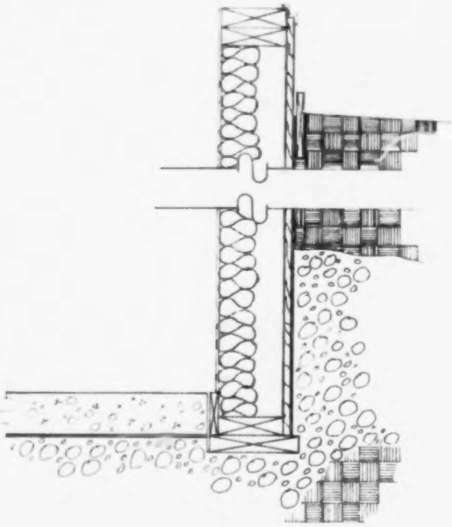
TEST

3. Label the types of wood foundations illustrated below and on the following page. Write the correct names in the blanks.



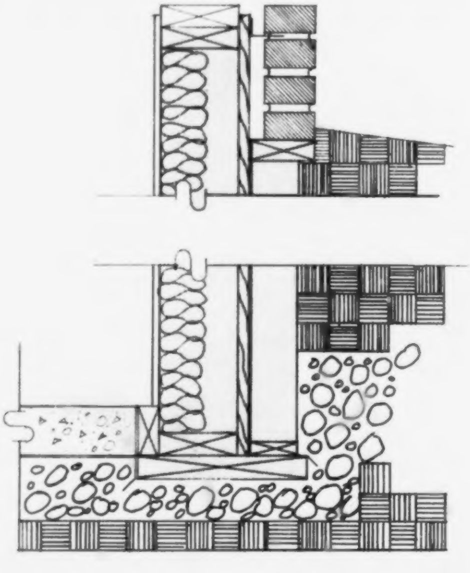
a. ______________________________

____

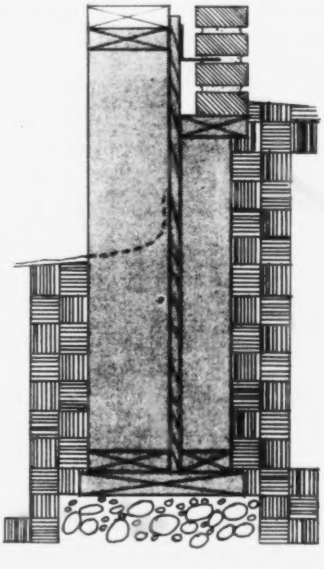


b. ______________________________

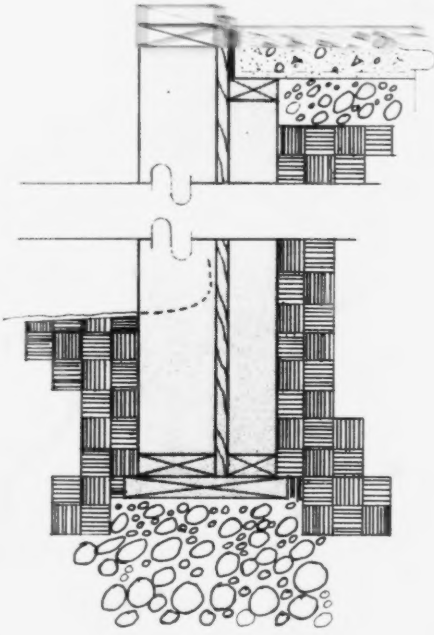
____

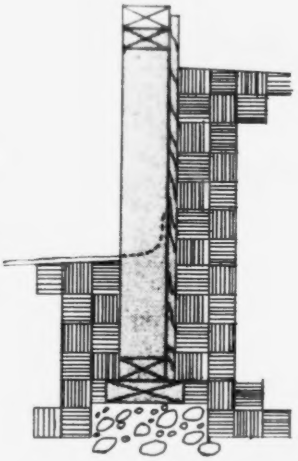


c. ______________________________



d. ______________________________



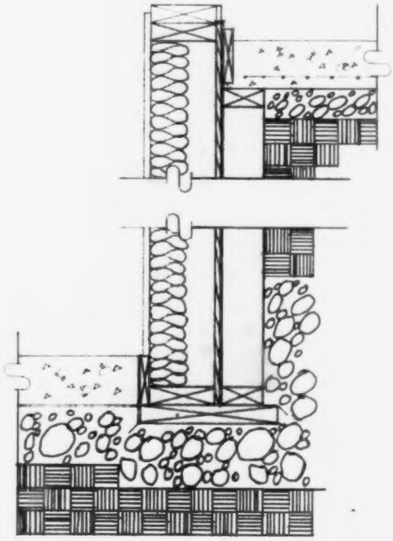


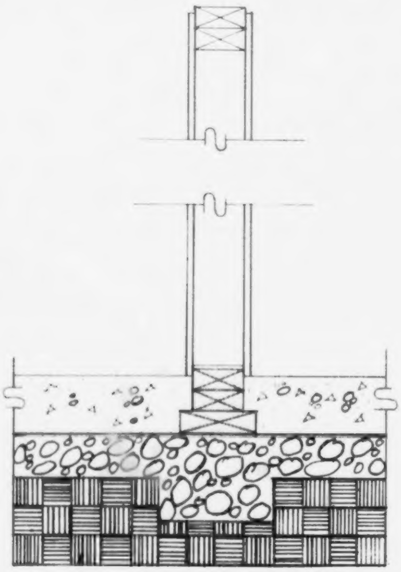
e. ______________________________

____

f. ______________________________

____





g. ______________________________

____

h. ______________________________

____

TEST

4. State methods used to construct wood foundations.

   a. ______________________________

   b. ______________________________

   c. ______________________________

5. State three benefits of using wood-foundation systems.

   a. ______________________________

   b. ______________________________

   c. ______________________________

(NOTE: Test question 6 lists the job sheet. It is an important part of this test. If it has not been completed, check with your instructor.)

6. Demonstrate the ability to install a crawl-space foundation wall.

WOOD FOUNDATIONS
UNIT III

ANSWERS TO TEST

1. a. 4
   b. 6
   c. 1
   d. 5
   e. 8
   f. 3
   g. 7
   h. 2

2. a. Flashing
   b. Top plate
   c. Wood strip protecting top of polyethylene film
   d. Plywood sheathing
   e. Strips of asphalt or polyethylene film
   f. Bottom plate
   g. Footing plate
   h. Gravel or crushed-stone footing
   i. Polyethylene film
   j. Basement slab
   k. Screed board
   l. Stud
   m. Insulation
   n. Warm-side vapor barrier
   o. Field-applied top plate

3. a. Wall supporting porch floor
   b. Basement
   c. Basement with brick veneer on knee wall
   d. Crawl space with brick veneer on knee wall
   e. Crawl space with porch knee wall
   f. Crawl space
   g. Basement with knee wall supporting garage or porch floor
   h. Basement bearing partition

4. a. Fabricated on site
   b. Prefabricated
   c. Built in place

5. Answer should include any three of the following

   a. Accurate scheduling
   b. Fast installation
   c. Installation in almost any type of weather
   d. Energy savings
   e. Easy finishing
   f. Economy

6. Performance skills evaluated to the satisfaction of the instructor.

SPECIAL APPLICATIONS
UNIT III

UNIT OBJECTIVE

After completing this unit, the sutdent should be able to identify types of special foundations and should know the local minimum depth for foundations. The student will show this knowledge by completing assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with special applications to their correct definitions.
2. Identify types of special foundations.
3. Discuss the classification of piers.
4. State the ratio of pier height to minimum transverse dimension.
5. Explain the need for different foundation types and sizes in various areas of the United States.
6. List the types of loads that act on a structure.
7. Compute maximum height of piers.
8. Determine minimum foundation depth for frost penetration.

SPECIAL APPLICATIONS
UNIT III

SUGGESTED ACTIVITIES

I. Unit contents

A. Objective sheet

B. Suggested activities

C. Transparency Master #1 — Safe Loads for Various Types of Foundation Beds

D. Information sheet

E. Student supplements

1. SS #1 — Average Annual Frost Penetration

2. SS #2 — Extreme Frost Penetration

F. Assignment sheets

1. Assignment Sheet #1 — Compute Maximum Height of Piers

2. Assignment Sheet #2 — Determine Minimum Foundation Depth for Frost Penetration

G. Answers to assignment sheets

H. Test

I. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Obtain materials to supplement unit.

1. Transparency

2. Competency profiles

(NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington D.C. 20006, phone 202-393-2040.)

SUGGESTED ACTIVITIES

3. Models of various types of piers
4. Local building codes
5. Small slab of concrete with V-shaped crevice
6. Soil samples

C. Introduce unit.

SUGGESTIONS:

- Display pictures of houses built with various types of special foundations and discuss the factors that led to these special requirements.
- Review Unit I, "Concrete Foundations," and Unit II, "Wood Foundations," and relate special applications to the information covered previously.

D. Provide students with objective sheet.

E. Discuss unit and specific objectives, relating the objectives to your introduction of the unit.

F. Provide students with information sheet.

G. Discuss information and assignment sheets.

1. Use Information Sheet, Section I to discuss terms associated with special applications.

   SUGGESTIONS:

   - Show examples of terms whenever possible.
   - Discuss local building regulations as they relate to foundation requirements.
   - Show students safe-load tables and other data sources related to special foundations.

2. Use Information Sheet, Section II to discuss types of special foundations, emphasizing types that may be found in your area.

   SUGGESTIONS:

   - Relate special applications to both concrete and wood foundations whenever pertinent.
   - Visit sites where such foundations can be found.

SUGGESTED ACTIVITIES

3. Use Information Sheet, Section III to discuss the classification of piers.

   SUGGESTIONS:

   - Use models to show the various types of piers.
   - Visit building sites where piers are being used.
   - Discuss piles, caissons, piers, and the uses of each.
   - Point out that a single pier may be described by more than one classification; for example, a pier may be solid, isolated, and straight.

4. Use Information Sheet, Section IV to discuss the ratio of pier height to minimum transverse dimension.

   SUGGESTIONS:

   - Use wood blocks to show how instability increases with height.
   - Modify ratio to conform with local building codes if required.
   - Use Assignment Sheet #1 to allow students to practice computing maximum pier heights.

5. Use Information Sheet, Section V to discuss the need for different foundation types and sizes.

   SUGGESTIONS:

   - Relate each type of foundation covered in Section II to frost penetration, terrain, and soil conditions.
   - Discuss requirements for depth due to frost penetration, emphasizing practices in your area; use Assignment Sheet #2 to provide students with practice in determining foundation-depth requirements.
   - Prepare a small slab of concrete with a V-shaped crevice, fill the crevice with water, and place it in a freezer overnight to demonstrate expansion.
   - Use a hydraulic jack under a footing to show the effects of freezing water or ground swelling.
   - Contact a representative from a company that specializes in correcting defective foundations; invite the representative to talk to the class about the problem.

SUGGESTED ACTIVITIES

- Provide the students with samples of various types of soils, and use Transparency #1 to discuss safe loads.
- Demonstrate how a wide footing area will support weight better than a narrow footing area, by having students find one narrow and one wide container of the same depth. Then have them place some thick mud in both containers and stack bricks on top of plywood squares to see which footing will support the most weight.

H. Give test.

I. Critique test and discuss in class.

J. Reteach if necessary.

K. Complete appropriate section of competency profiles.

III. References

A. Buettner, Donald R., James M. Fisher, and Curtis B. Miller. *Metal Building Systems.* Cincinnati, Ohio: Johnson and Hardin Co., 1980.

B. Graham, Frank D. *Audels Masons and Builders Guide #2.* Indianapolis, Indiana, and New York: Theodore Audel and Co., a division of Howard Sams and Co., Inc., 1967.

C. *Manual of Acceptable Practices.* Washington, D.C.: U.S. Department of Housing and Urban Development, 1973.

D. Ramsey, Charles G., and Harold R. Sleeper. *Architectural Graphic Standards,* 6th ed. New York: John Wiley and Sons, Inc., 1970.

Safe Loads for Various Types of Foundation Beds

Foundation Bed	Safe Load (Tons per Square Foot)
Ordinary clay	2
Fine sand	2
Clay with large percentage of sand	4
Coarse sand	5
Gravel	5
Boulders	5
Hard pan	10
Rock	15-30

(NOTE: Other factors such as terrain, soil mixture, and water content of bed may alter safe-load figures.)

SPECIAL APPLICATIONS
UNIT III

INFORMATION SHEET

I. Terms and definitions

   A. Foundation — Walls or piers that are below the grade line and support a structure

   B. Girder — Timber or steel beam used as the main support of a structure; also a beam used to support concentrated loads at isolated points along the structure's length

   C. Pier — Detached part of foundation used to support the girders

   D. Transverse dimension — Measurement of the width of a pier

   (NOTE: The *minimum transverse dimension* is the smallest dimension of a pier, such as 12 inches in a 12" x 18" pier.)

   E. Pile — Long, slender timber, concrete, or steel structural element that is driven, jetted, or otherwise embedded on end into the ground to support a load

   F. Caisson — Watertight hollow tube or chamber that is driven into the ground, filled with concrete, and used to support a structure

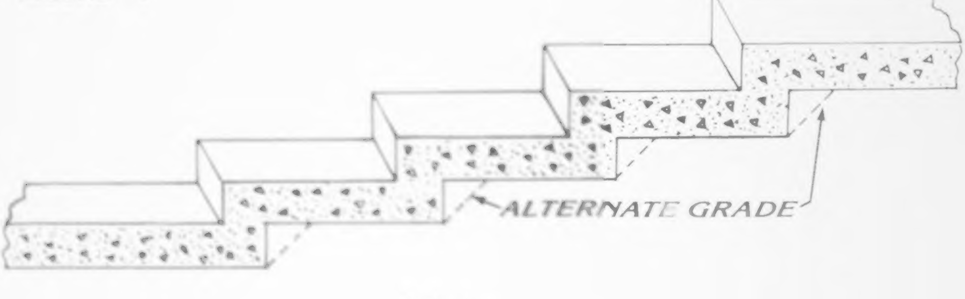
   G. Safe load — Weight capacity that a support member can carry without breakdown

   H. Local building regulations — Building codes, zoning laws, and other legal documents giving the minimum requirements and restrictions that the contractor must comply with when building a structure within a locality

II. Types of special foundations (Figures 1-7)

   A. Stepped, continuous foundation

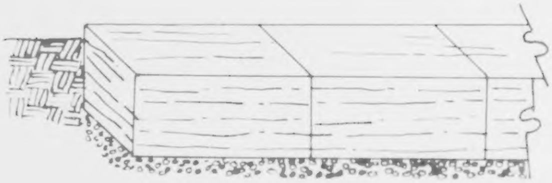
FIGURE 1



INFORMATION SHEET

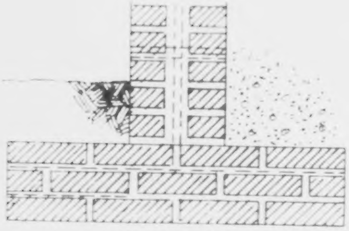
B. Granite-slab foundation

FIGURE 2



C. Masonry foundation

FIGURE 3



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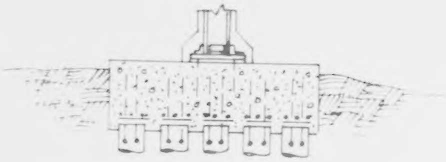
D. Pile and pile-cap foundation

FIGURE 4



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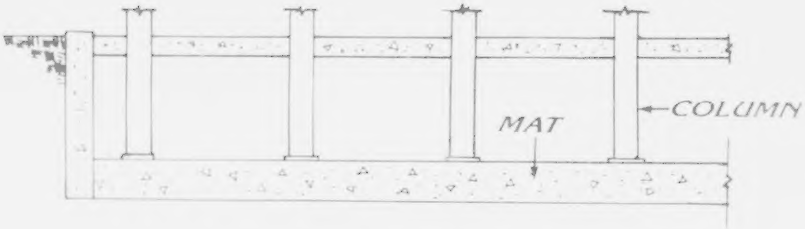
INFORMATION SHEET

E. Mat (raft) foundation

(NOTE: A mat foundation is used over deep soil with a low bearing capacity.)

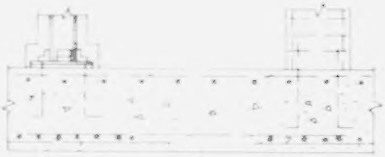
FIGURE 5



Source: Systems Builder's Association, Arlington, Texas.

F. Combined foundation

FIGURE 6



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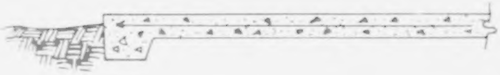
G. Earth-slab foundation on grade with thickened edge (monolithic pour)

FIGURE 7



125 B

INFORMATION SHEET

III. Classification of piers

   A. With respect to construction

      1. Solid

      2. Hollow

   B. With respect to location

      1. Isolated

      2. Connected

   C. With respect to shape

      1. Straight

      2. Battered

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IV. Ratio of pier height to minimum transverse dimension — No isolated pier should be more than ten times higher than its shortest transverse dimension

EXAMPLE: 12" x 18" pier should be no more than 120 inches in height

V. Different foundation types and sizes are needed in various areas of the United States — because of differences in frost penetration, terrain, and soil conditions

(NOTE: Foundation size is determined by the frost penetration of the area. For example, the foundation must always be below the frost line, and therefore, deep foundations are required in cold regions where there is deep frost penetration. Foundation type is determined by the terrain and the soil conditions of the area. For example, special foundations and piles are required for rough terrain, and mat and raft foundations are required over soils that provide poor support.)

VI. Types of loads that act on a structure

   A. Vertical loads

      EXAMPLES: Weight of snow, total structure weight

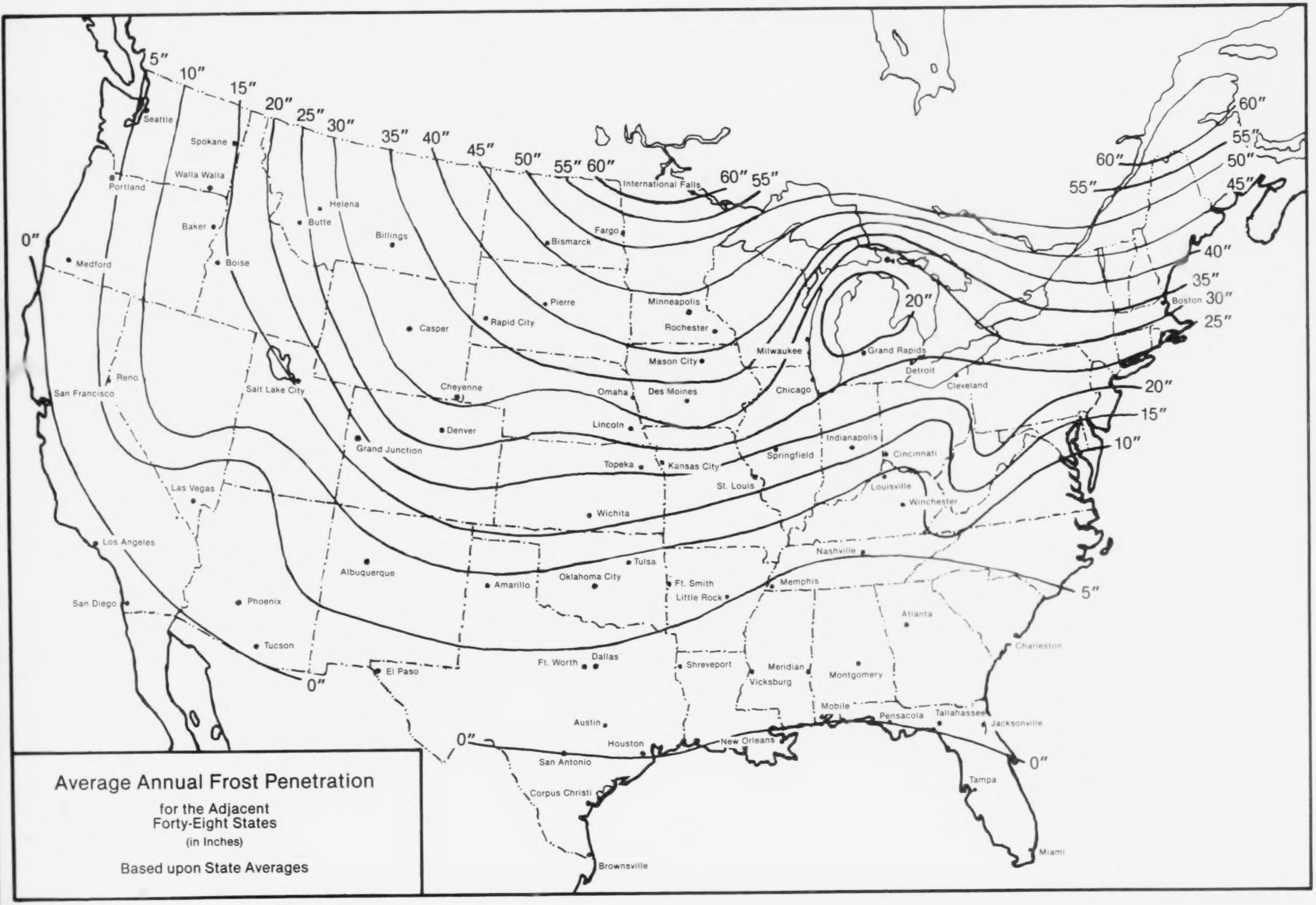
   B. Horizontal loads

      EXAMPLES: Wind, pressure from earth piled along foundations, seismic pressure (earthquake)

   C. Combination vertical and horizontal loads

      (NOTE: This type of load may cause tipping or rotation.)

STUDENT SUPPLEMENT #1


5"
10"
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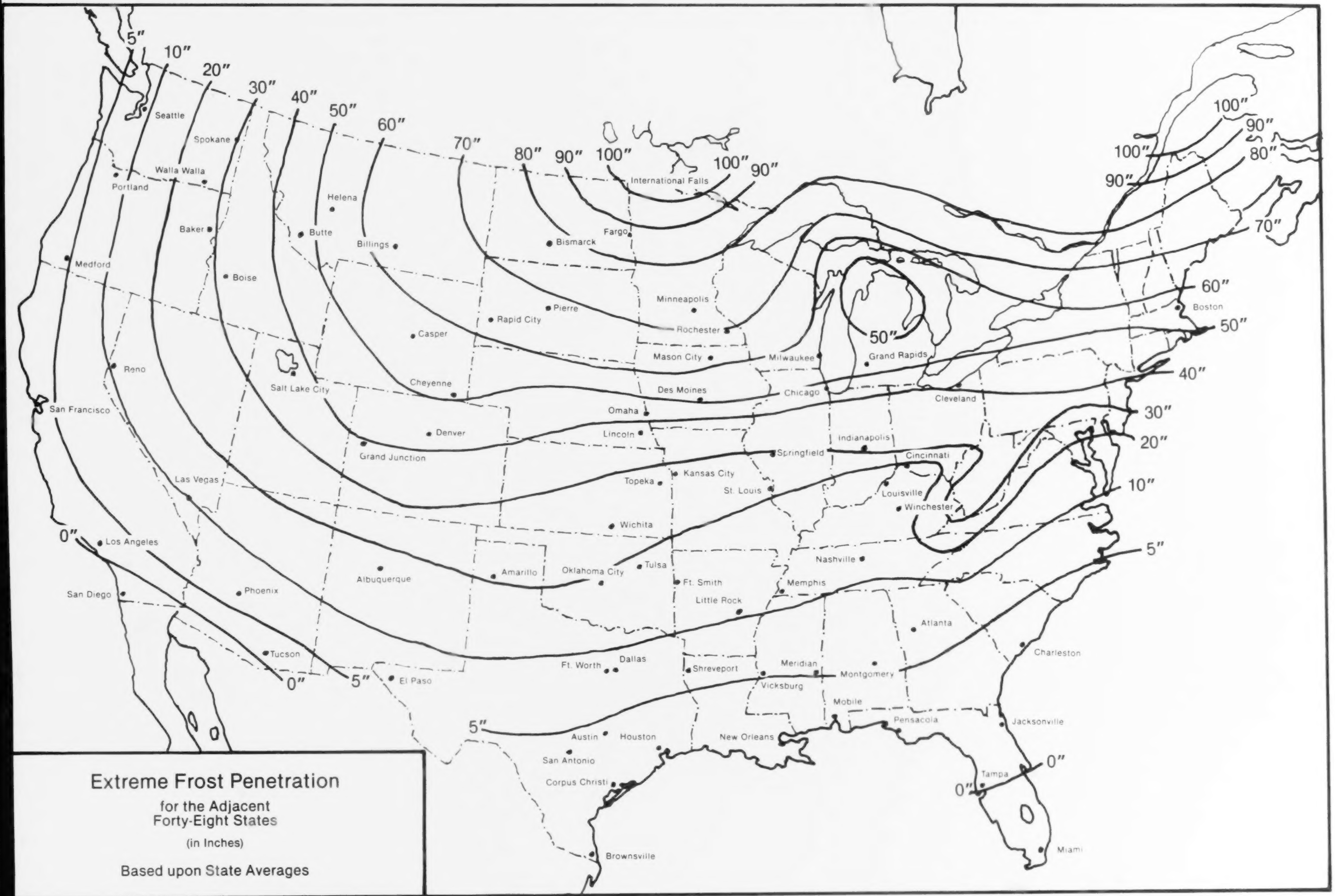
Rochester
Casper
Rapid City
Mason City
Milwaukee
Grand Rapids
Detroit
Boston
Reno
San Francisco
Salt Lake City
Cheyenne
Omaha
Des Moines
Chicago
Cleveland
Denver
Lincoln
Grand Junction
Indianapolis
Cincinnati
Springfield
Topeka
Kansas City
St. Louis
Louisville
Winchester
Las Vegas
Wichita
Los Angeles
Nashville
Tulsa
Albuquerque
Oklahoma City
Amarillo
Ft. Smith
Memphis
Little Rock
San Diego
Phoenix
Atlanta
Tucson
Charleston
Dallas
Ft. Worth
El Paso
Shreveport
Meridian
Montgomery
Vicksburg
Mobile
Pensacola
Tallahassee
Jacksonville
Austin
Houston
New Orleans
San Antonio
Tampa
Corpus Christi
Miami
Brownsville

Average Annual Frost Penetration

for the Adjacent
Forty-Eight States
(in Inches)

Based upon State Averages

STUDENT SUPPLEMENT #2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Kansas City
Topeka
St. Louis
Louisville
Winchester
Las Vegas
Wichita
Los Angeles
Amarillo
Oklahoma City
Tulsa
Nashville
Albuquerque
Ft. Smith
Memphis
San Diego
Phoenix
Little Rock
Atlanta
Tucson
Ft. Worth
Dallas
Shreveport
Meridian
Montgomery
Charleston
El Paso
Vicksburg
Mobile
Pensacola
Jacksonville
Austin
Houston
New Orleans
San Antonio
Corpus Christi
Tampa
Brownsville
Miami

Extreme Frost Penetration

for the Adjacent
Forty-Eight States

(in Inches)

Based upon State Averages

SPECIAL APPLICATIONS
UNIT III

ASSIGNMENT SHEET #1 — COMPUTE MAXIMUM HEIGHT OF PIERS

NAME ______________________________ SCORE ______________

If a building is to remain standing, its foundation must be able to support the structure and the forces acting upon it. In foundations using piers, the piers must provide a strong base. The taller a pier of a given width and thickness, the weaker it is. Thus, a carpenter must be able to determine the maximum safe height for a pier. If the height required is more than the safe height, the base dimension of the pier must be increased.

Compute the maximum height of the following piers using the ratio of pier height to minimum transverse dimension. Write the correct answers in the blanks and show your work.

A. Pier is 12" x 12". Maximum height = ______________________________

B. Pier is 16" x 18". Maximum height = ______________________________

C. Pier is 18" x 18". Maximum height = ______________________________

D. Pier is 18" x 30". Maximum height = ______________________________

E. Pier is 20" x 30". Maximum height = ______________________________

SPECIAL APPLICATIONS
UNIT III

ASSIGNMENT SHEET #2 — DETERMINE MINIMUM FOUNDATION DEPTH FOR FROST PENETRATION

NAME ______________________________ SCORE ______________

Frost can destroy a foundation. When water seeps into cracks and joints and then freezes, the pressure from expansion acts like a powerful wedge. To be protected from these forces, foundations must reach below the frost line (depth of frost penetration). A carpenter must be able to determine how deep a foundation must go.

Using the information from Student Supplements #1 and #2, write the minimum foundation depth for each location listed. Give both the depth for average annual frost penetration and extreme frost penetration.

Location	Average Frost Penetration	Extreme Frost Penetration
A. Dallas, Texas	______________	______________
B. Grand Rapids, Michigan	______________	______________
C. San Diego, California	______________	______________
D. Butte, Montana	______________	______________
E. Boston, Massachusetts	______________	______________
F. Kansas City, Missouri	______________	______________
G. Seattle, Washington	______________	______________
H. Charleston, South Carolina	______________	______________
I. Rapid City, South Dakota	______________	______________
J. Your hometown	______________	______________

SPECIAL APPLICATIONS
UNIT III

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. 120″ or 10′
B. 160″ or 13′ –4″
C. 180″ or 15′
D. 180″ or 15′
E. 200″ or 16′ –8″

Assignment Sheet #2

Location	**Average Frost Penetration**	**Extreme Frost Penetration**
A. Dallas, Texas	5″	10″
B. Grand Rapids, Michigan	20″	50″
C. San Diego, California	0″	0″
D. Butte, Montana	25″	50″
E. Boston, Massachusetts	35″	60″
F. Kansas City, Missouri	20″ to 22″	30″
G. Seattle, Washington	5″	10″
H. Charleston, South Carolina	2″ to 5″	5″
I. Rapid City, South Dakota	35″	60″
J. Your hometown	Evaluated to the satisfaction of the instructor	

SPECIAL APPLICATIONS
UNIT III

TEST

NAME ____ SCORE ________________

1. Match terms associated with special applications to their correct definitions. Write the correct numbers in the blanks.

______a. Weight capacity that a support member can carry without breakdown

______b. Timber or steel beam used as the main support of a structure; also a beam used to support concentrated loads at isolated points along the structure's length

______c. Measurement of the width of a pier

______d. Long, slender timber, concrete, or steel structural element that is driven, jetted, or otherwise embedded on end into the ground to support a load

______e. Watertight hollow tube or chamber that is driven into the ground, filled with concrete, and used to support a structure

______f. Building codes, zoning laws, and other legal documents giving the minimum requirements and restrictions that the contractor must comply with when building a structure within a locality

______g. Detached part of foundation used to support the girders

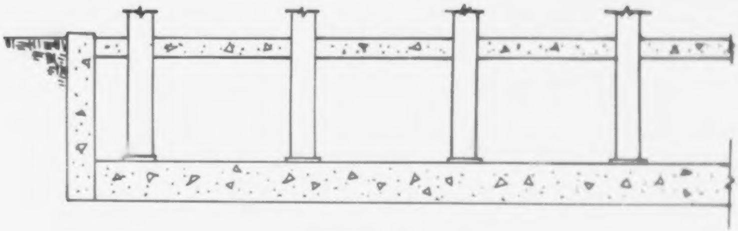
______h. Walls or piers that are below the grade line and support a structure

1. Transverse dimension
2. Caisson
3. Pier
4. Safe load
5. Girder
6. Pile
7. Foundation
8. Local building regulations

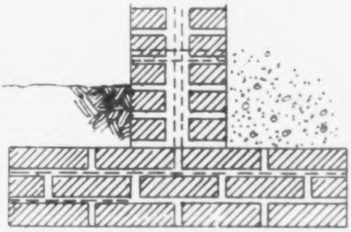
TEST

2. Identify the types of special foundations illustrated below and on the following page. Write the correct names in the blanks.

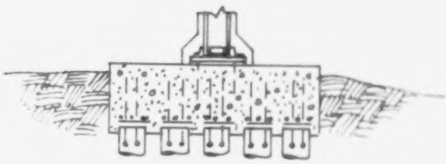
Masonry foundation
Granite-slab foundation
Combined foundation
Stepped, continuous foundation
Pile and pile-cap foundation
Mat (raft) foundation
Earth-slab foundation on grade with thickened edge (monolithic pour)



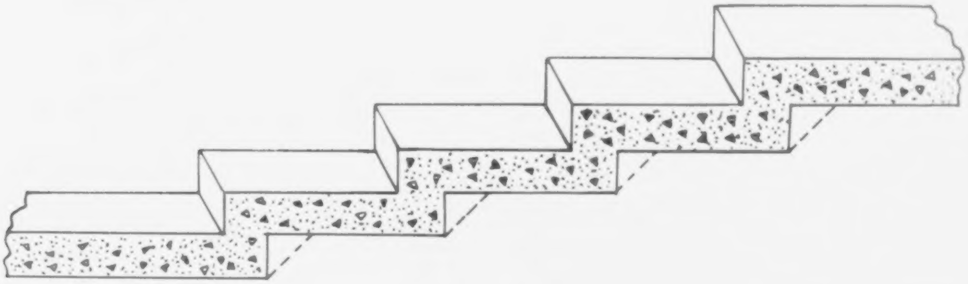
a. ______________________________



b. ______________________________

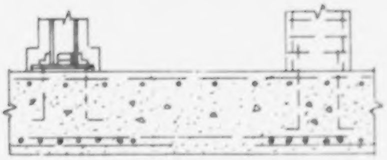


c. ______________________________

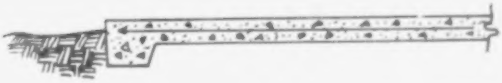


d. ______________________________

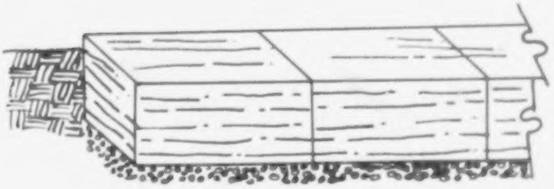
TEST



e. ______________________



f. ______________________



g. ______________________

3. Discuss the classification of piers. In the blanks provided, write the ways in which piers may be classified for each category listed.

   a. With respect to construction

      (1) ______________________

      (2) ______________________

   b. With respect to location

      (1) ______________________

      (2) ______________________

TEST

c. With respect to shape

(1) ______________________________

(2) ______________________________

4. State the ratio of pier height to minimum transverse dimension.

____

____

5. Explain the need for different foundation types and sizes in various areas of the United States.

____

____

6. List the types of loads that act on a structure.

a. ______________________________

b. ______________________________

c. ______________________________

(NOTE: Test questions 7 and 8 list the assignment sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

7. Compute maximum height of piers.

8. Determine minimum foundation depth for frost penetration.

SPECIAL APPLICATIONS
UNIT III

ANSWERS TO TEST

1. a. 4
   b. 5
   c. 1
   d. 6
   e. 2
   f. 8
   g. 3
   h. 7

2. a. Mat (raft) foundation
   b. Masonry foundation
   c. Pile and pile-cap foundation
   d. Stepped, continuous foundation
   e. Combined foundation
   f. Earth-slab foundation on grade with thickened edge (monolithic pour)
   g. Granite-slab foundation

3. Discussion should include the following

   a. With respect to construction

      (1) Solid
      (2) Hollow

   b. With respect to location

      (1) Isolated
      (2) Connected

   c. With respect to shape

      (1) Straight
      (2) Battered

4. No isolated pier should be more than ten times higher than its shortest transverse dimension

5. Explanation should include the following

   Because of differences in frost penetration, terrain, and soil conditions

6. a. Vertical loads
   b. Horizontal loads
   c. Combination vertical and horizontal loads

ANSWERS TO TEST

7. Evaluated to the satisfaction of the instructor

8. Evaluated to the satisfaction of the instructor

FOOTING AND FOUNDATION FORMS
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to construct forms for continuous and pier footings and prepare footing forms for erection in another location. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with footing and foundation forms.
2. Discuss external factors that affect form design.
3. Identify the parts of a form.
4. Identify types of form ties and clamps.
5. Name methods of form construction for footings.
6. Demonstrate the ability to
    a. Set forms for a continuous footing.
    b. Construct and set forms for a pier footing.
    c. Strip pier-footing forms and prepare forms for erection at another location.

FOOTING AND FOUNDATION FORMS
UNIT I

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Supplement #1 — Importance of Form Design

   D. Information sheet

   E. Job sheets

      1. Job Sheet #1 — Set Forms for a Continuous Footing

      2. Job Sheet #2 — Construct and Set Forms for a Pier Footing

      3. Job Sheet #3 — Strip Pier-Footing Forms and Prepare Forms for Erection at Another Location

   F. Test

   G. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

   B. Obtain materials to supplement unit.

      1. Equipment and materials for procedures outlined in the job sheets

      2. Copies of supplement as appropriate

      3. Competency profiles

         (NOTE: Competency profiles for this book are available from the Curriculum and Instructional Materials Center, State Department of Vocational and Technical Education, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street N.W., Washington, D.C. 20006; phone 202-393-2040.)

      4. Resource materials

         a. Books

SUGGESTED ACTIVITIES

1) Latest edition of *Modern Carpentry* by Willis H. Wagner

(NOTE: Order from the Goodheart-Willcox Co., 123 West Taft Drive, South Holland, Illinois 60473.)

2) Latest edition of *Carpentry* by Caspar J. Lewis

(NOTE: Order from Delmar Publishers Incorporated, 2 Computer Drive West, Box 15-015, Albany, New York 12212.)

b. Film — *The Foundation*

(NOTE: This film illustrates the step-by-step procedure for building a concrete basement and includes a section on pouring footings. It is available on a free-loan basis to Oklahoma teachers, who may order from the State Department of Vocational and Technical Education, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074. Out-of-state teachers may order from Circle Oak Productions, 73 Girdle Ridge Drive, Katonah, New York 10536.)

5. Set of local building codes and zoning restrictions

6. Examples of various form ties and clamps

C. Introduce unit.

SUGGESTIONS:

- Stress the importance of a good, solid foundation.
- Show students examples of different types of footings and foundations and explain their differences.
- Take students on a field trip to local housing developments that are in the process of building forms and pouring footings and foundations. Explain to the students the different methods and techniques used by different contractors.

D. Prepare sites by digging excavations and erecting batter boards so that students may complete Job Sheets #1 and #2.

E. Provide students with objective sheet.

F. Discuss unit and specific objectives.

G. Provide students with information and job sheets.

H. Discuss information and job sheets.

SUGGESTED ACTIVITIES

1. Use Information Sheet, Section I to introduce terms and definitions associated with footing and foundation forms.

   SUGGESTION:

   - Show students examples of appropriate terms.

2. Use Information Sheet, Section II to discuss external factors that affect form design.

   SUGGESTIONS:

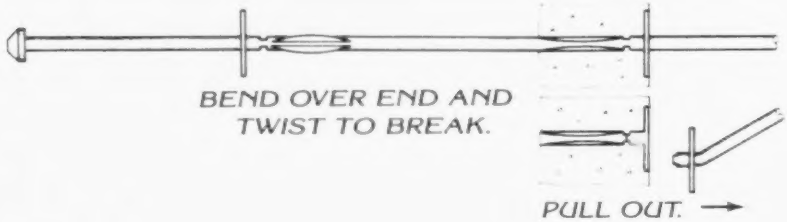
   - Provide students with copies of Supplement #1 for future reference. Discuss.
   - Review Unit I, "Concrete Foundations" in Section B of this manual. Explain in detail how external factors affect form design.
   - Explain why forms must be level and straight.
   - Have students build forms, using different materials to compare strengths and stress on the forms when they are poured and vibrated.

3. Use Information Sheet, Sections III and IV to discuss the parts of a form and types of form ties and clamps.

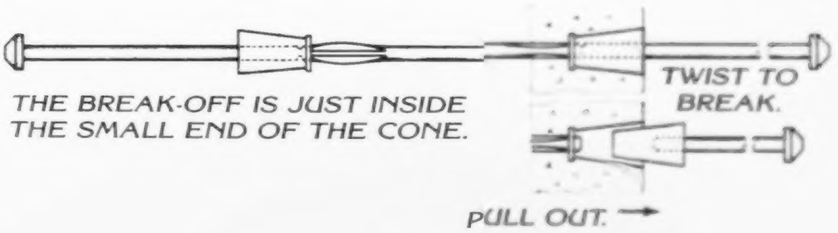
   SUGGESTIONS:

   - Show students the individual parts of a form. Demonstrate how the parts go together, and explain why forms are constructed in such a manner.
   - Show students examples of the different types of form ties and clamps. Explain the use of each, and demonstrate how to install the various ties.

   EXAMPLES:



SUGGESTED ACTIVITIES



4. Use Information Sheet, Section V to discuss methods of form construction for footings.

   SUGGESTIONS:

   - Have students demonstrate their ability to lay out footings on the shop floor before actual construction in the field.
   - Have students demonstrate their ability to transfer grades from one stake to another, using a builder's level and hand level.
   - Have each student demonstrate the ability to drive a stake to grade.
   - Show students examples of different sizes of rebars and have them become familiar with the sizes and their uses in the construction of footings and foundations.
   - Explain where and how reinforcing should be used. Explain types and sizes of reinforcing, methods used to hold reinforcing in place, and reasons reinforcing is placed at particular depths and covered with a certain amount of concrete.
   - Explain types, sizes, and reasons for keyways.
   - Demonstrate and discuss procedures outlined in Job Sheets #1 and #2. Have students complete Job Sheets #1 and #2.
   - Demonstrate and discuss procedures outlined in Job Sheet #3. Have students complete Job Sheet #3. Observe the students closely. If they chip or break the concrete in the process, explain why this happened.

I. Give test.

J. Critique test and discuss in class.

K. Reteach if necessary.

L. Complete appropriate section of competency profiles.

SUGGESTED ACTIVITIES

III. Unit references

A. Burke, Arthur E., J. Ralph Danzell, and Gilbert Townsend. *Architectural and Building Trades Dictionary,* 2nd ed. Chicago, Illinois: American Technical Society, 1955.

B. Durham, Walter E., and Elmer W. Sundberg. *Fundamentals of Carpentry,* 3rd ed. Chicago, Illinois: American Technical Society, 1963.

C. Hendrix, Laborn J. "Bud." *Commercial Carpentry.* Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1979.

D. Moore, Cairl E. *Concrete Form Construction.* Albany, New York: Delmar Publishers, 1977.

E. Penner, Wayman R. *Residential Carpentry.* Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1973.

F. Peurifoy, R. L. *Framework for Concrete Structures.* New York: McGraw-Hill Book Company, 1964.

G. Smith, Ronald C. *Principles and Practices of Light Construction.* Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1970.

H. Wagner, Willis H. *Modern Carpentry.* South Holland, Illinois: Goodheart-Willcox Co., Inc., 1969.

I. Waugh, Herbert R., and Nelson L. Burbank. *Building Terms and Definitions.* New York: Simmons-Boardman Publishing Corporation, n.d.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — IMPORTANCE OF FORM DESIGN

Many types of footing and foundation form designs and patented forms are on the market. Regardless of the design or type of form system you use or the method you use for erecting forms, follow these basic considerations. Forms must be tight, smooth, free of defects, and properly aligned. Forms must also be strong and properly braced. If the bracing seems inadequate, add more bracing. It is better to overbrace than to lose a form. Various types of manufactured braces, clamps, and ties are available to help you build strong forms. Forms and accessories can also be purchased from manufacturers, and some suppliers rent or lease forms.

Form design is very important because a good carpenter reuses the forms. To speed erection and stripping, use form panels whenever possible; and to prevent damage to the panels so that they may be reused, use the minimum number of nails necessary to erect the panels.

After removing the panels, devote a little time to maintaining the forms. Clean the forms thoroughly, make repairs as necessary, coat each form with form oil, stack neatly, and protect from the weather.

FOOTING AND FOUNDATION FORMS
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Form — Temporary structure or mold for the support of concrete while it is setting in a desired shape and gaining sufficient strength to be self-supporting

B. Footing — Enlarged area at base of foundation designed to distribute weight of superstructure

C. Foundation — Substructure below first-floor construction or grade, including footing; supports the structure

D. Form oil — Paraffin product or other manufactured product used on forms to prevent adhesion of concrete to form

E. Bulkhead — Board placed in a form to cut off concrete pour

F. Rate of pour — Depth, in feet, of concrete poured in one hour

G. Boil board — Wide board placed around bottom of form to prevent concrete from rising up around form

H. Pier — Any solid masonry support

I. Pilaster — Right-angled column or pillar projection from a pier or wall

J. Dowel rod — Steel bar inserted into concrete to help tie adjoining concrete together

K. Reinforcing bar (rebar) — Deformed steel bar used to strengthen concrete

(NOTE: The size of a reinforcing bar is based on the number of eighth-inch increments in the nominal diameter of the bar. For instance, a #4 bar is $^{4}/_{8}$ inch or $^{1}/_{2}$ inch in diameter.)

L. Template — Thin blade or board frame used as a guide in positioning form parts

EXAMPLE: Bolt template

M. Grade point — Finish level of concrete in a form

II. External factors and their effects on form design

A. Amount of pressure to be placed on form

INFORMATION SHEET

1. Rate of pour — The faster the rate of pour, the greater the pressure exerted

   (NOTE: For a given rate of pour, the pressure will be the same on a 4-inch wide wall as it is on a 12-inch wide wall.)

2. Vibration — Power vibration can cause pressure to increase as much as 35 percent

3. Method of placement — The greater the height of the drop and the mass of concrete, the greater the pressure increase

   (NOTE: Concrete weighs 150 pounds per square foot, and the impact of this weight on concrete already placed causes an increase in pressure on the form. High, free drops of concrete cause aggregate separation.)

B. Length of time pressure is to remain on form

1. Slump — The greater the slump, the longer it takes concrete to set, causing pressure to remain on the form for a longer period of time

2. Temperature — The higher the temperature, the faster concrete sets

   (NOTE: With a rate of pour of 4 feet per hour at 70°F, the maximum pressure on the form is 550 pounds per square foot. Using the same rate of pour at 50°F, the maximum pressure increases to 750 pounds per square foot.)

C. Type of concrete finish

1. Architectural concrete — Is exposed in finished structure, thus requires forms designed to give minimum deflection and leakage

   (NOTE: Exposed concrete may be finished in a number of ways for texture or appearance. For example, the finish may be rough, smooth, incised, sculptured, sandblasted, bushhammered, or finished in other ways.)

2. Structural concrete — Is not exposed in finished structure, thus allows form design that permits some deflection and leakage

III. Parts of a form (See Figures 1 and 2)

INFORMATION SHEET

FIGURE 1

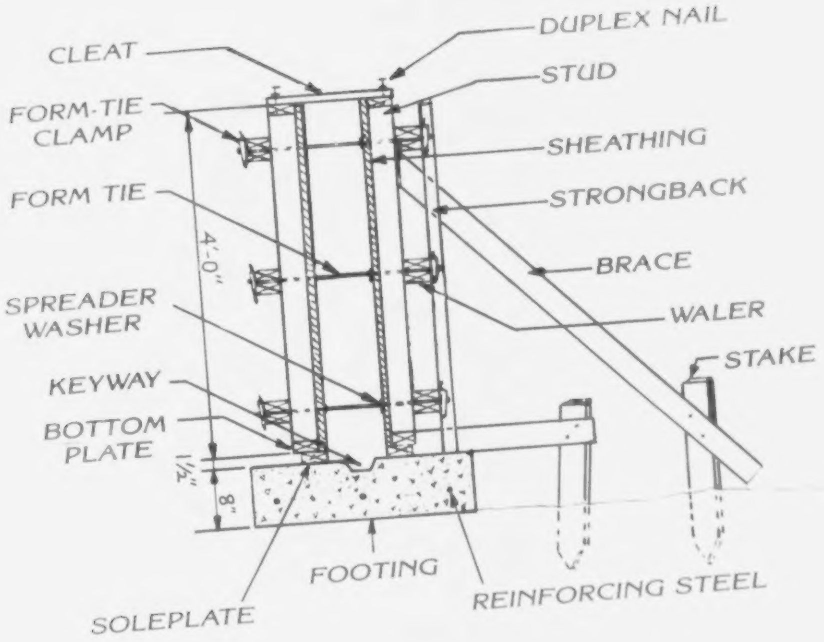
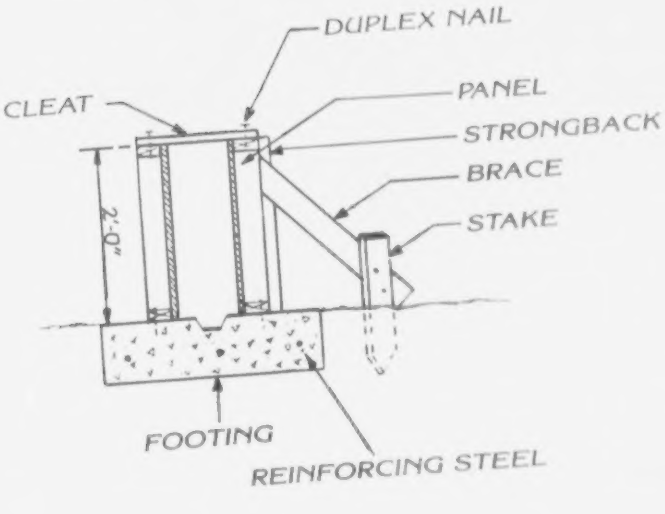

CLEAT
DUPLEX NAIL
STUD
FORM-TIE CLAMP
SHEATHING
FORM TIE
STRONGBACK
BRACE
4'-0"
SPREADER WASHER
WALER
STAKE
KEYWAY
BOTTOM PLATE
1½"
8"
FOOTING
REINFORCING STEEL
SOLEPLATE

FIGURE 2

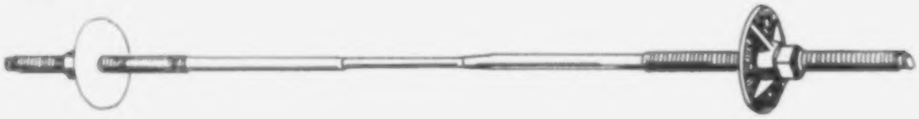

DUPLEX NAIL
CLEAT
PANEL
STRONGBACK
BRACE
STAKE
2'-0"
FOOTING
REINFORCING STEEL

INFORMATION SHEET

IV. Types of form ties and clamps (Figures 3-11)

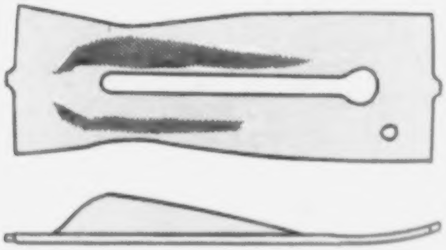
A. She-bolt assembly

FIGURE 3



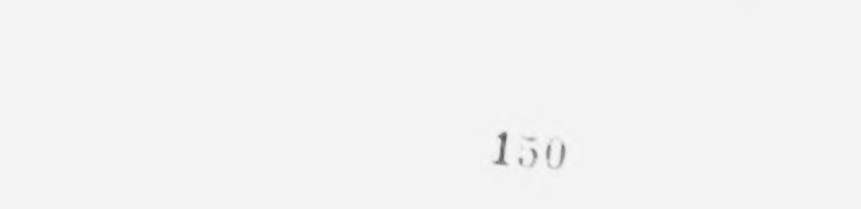
B. Wall-tie clamp

FIGURE 4



C. Wall-tie assembly

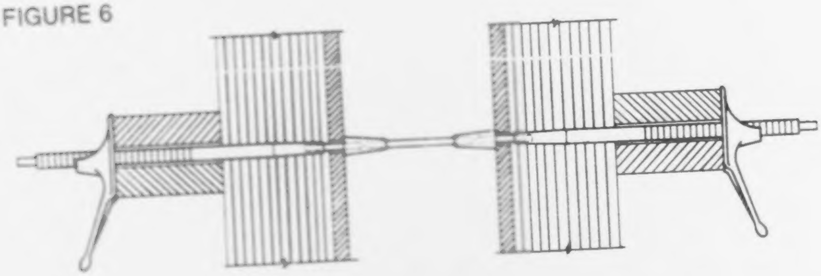
FIGURE 5



INFORMATION SHEET

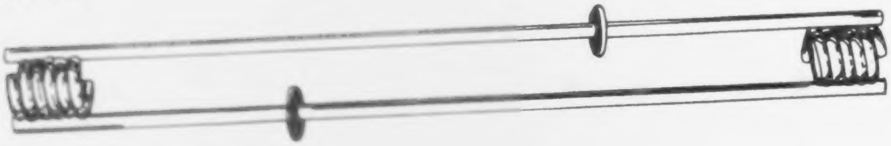
D. Threaded-rod wall-tie assembly

FIGURE 6



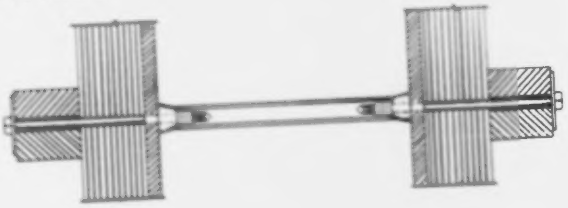
E. Waterseal coil tie

FIGURE 7



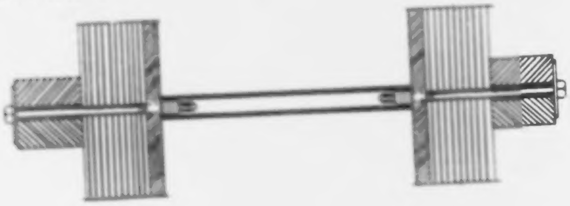
F. Coil tie with spreader cone

FIGURE 8



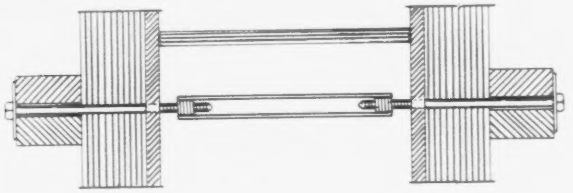
G. Coil tie as spreader and tie

FIGURE 9



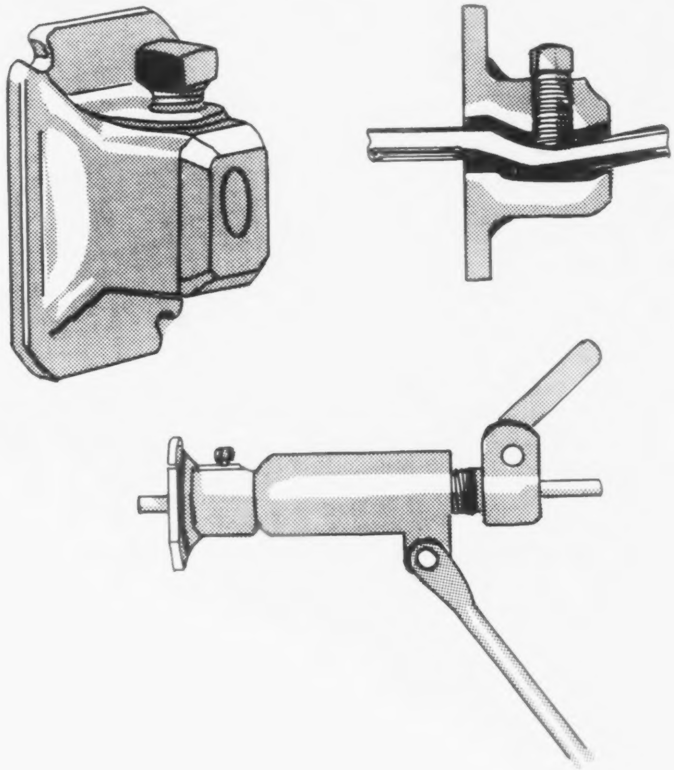
H. Coil tie with separate spreader

FIGURE 10



I. Form clamps (buttons) used with plain, round, mild-steel rods

FIGURE 11



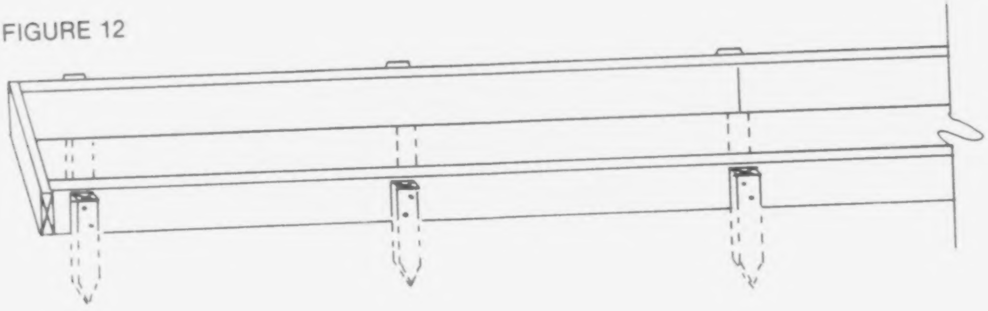
INFORMATION SHEET

V. Methods of form construction for footings (Figures 12 and 13)

A. Built on site

EXAMPLE:

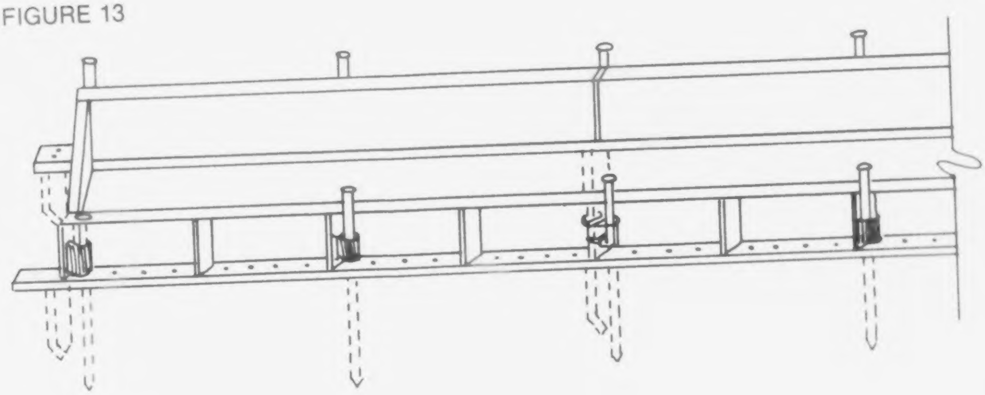
FIGURE 12



B. Prefabricated, patented

EXAMPLE:

FIGURE 13



FOOTING AND FOUNDATION FORMS
UNIT I

JOB SHEET #1 — SET FORMS FOR A CONTINUOUS FOOTING

I. Tools and materials

   A. Tools

      1. Power handsaw and extension cord
      2. Handsaw
      3. Claw hammer
      4. Sledgehammer
      5. One-hundred-foot tape
      6. Folding rule or steel tape
      7. Hand level
      8. String line
      9. Builder's level
      10. Plumb bob
      11. Large brush, spray can, roller, or mop for applying form oil

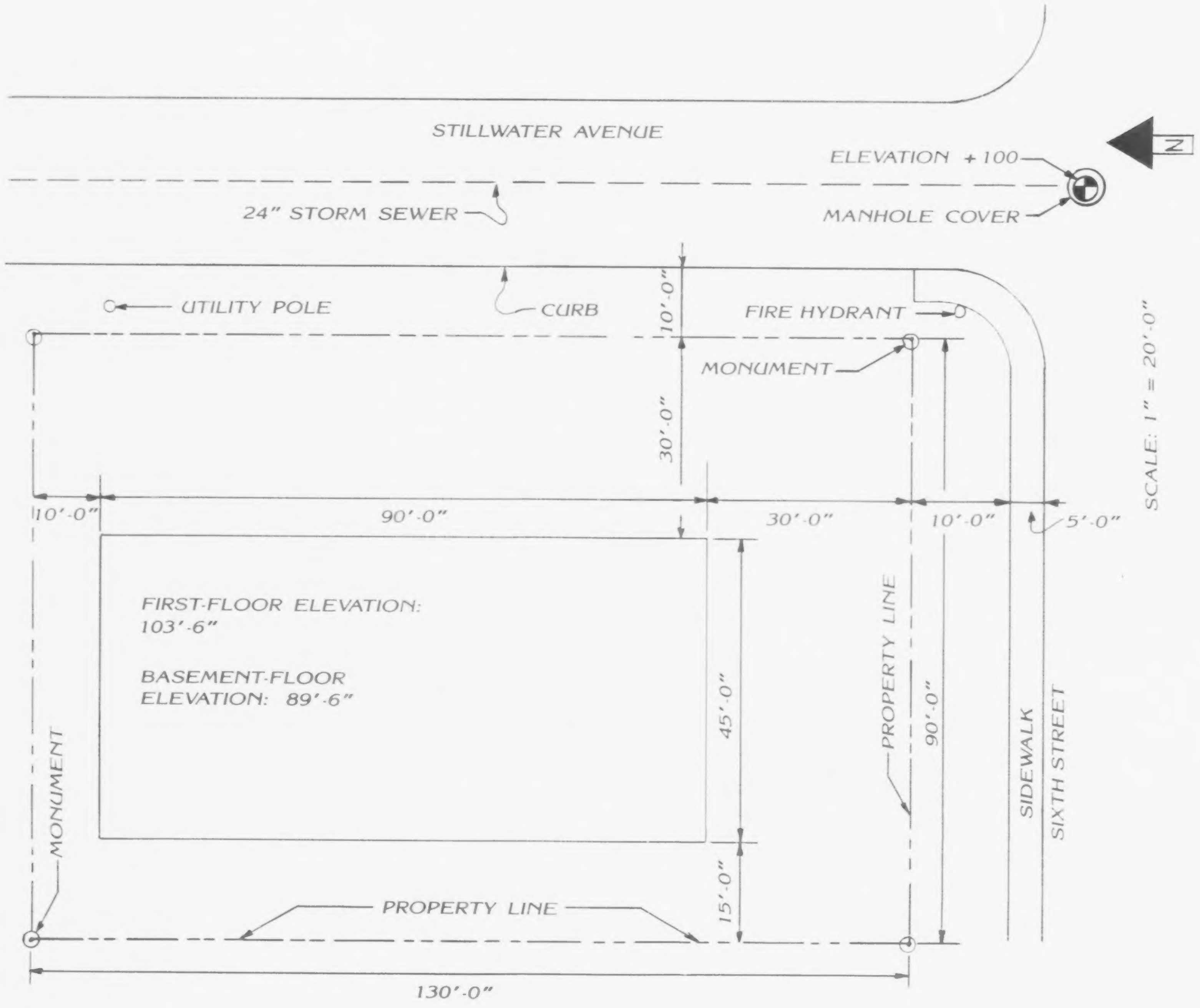
   B. Materials

      1. Form stakes, 2" × 4" × 18"
      2. Form boards, 2" × 12" × 520'
      3. Corner and hub stakes, 2" × 2" × 1'
      4. Precut spreaders, 2" × 8" × 3'
      5. 1×4s for cleats
      6. 8d and 16d duplex nails
      7. Form oil
      8. Plans

         (NOTE: The plans listed below are shown on the next two pages.)

         a. Plot Plan, Sheet #1
         b. Foundation Plan, Sheet #2

JOB SHEET #1

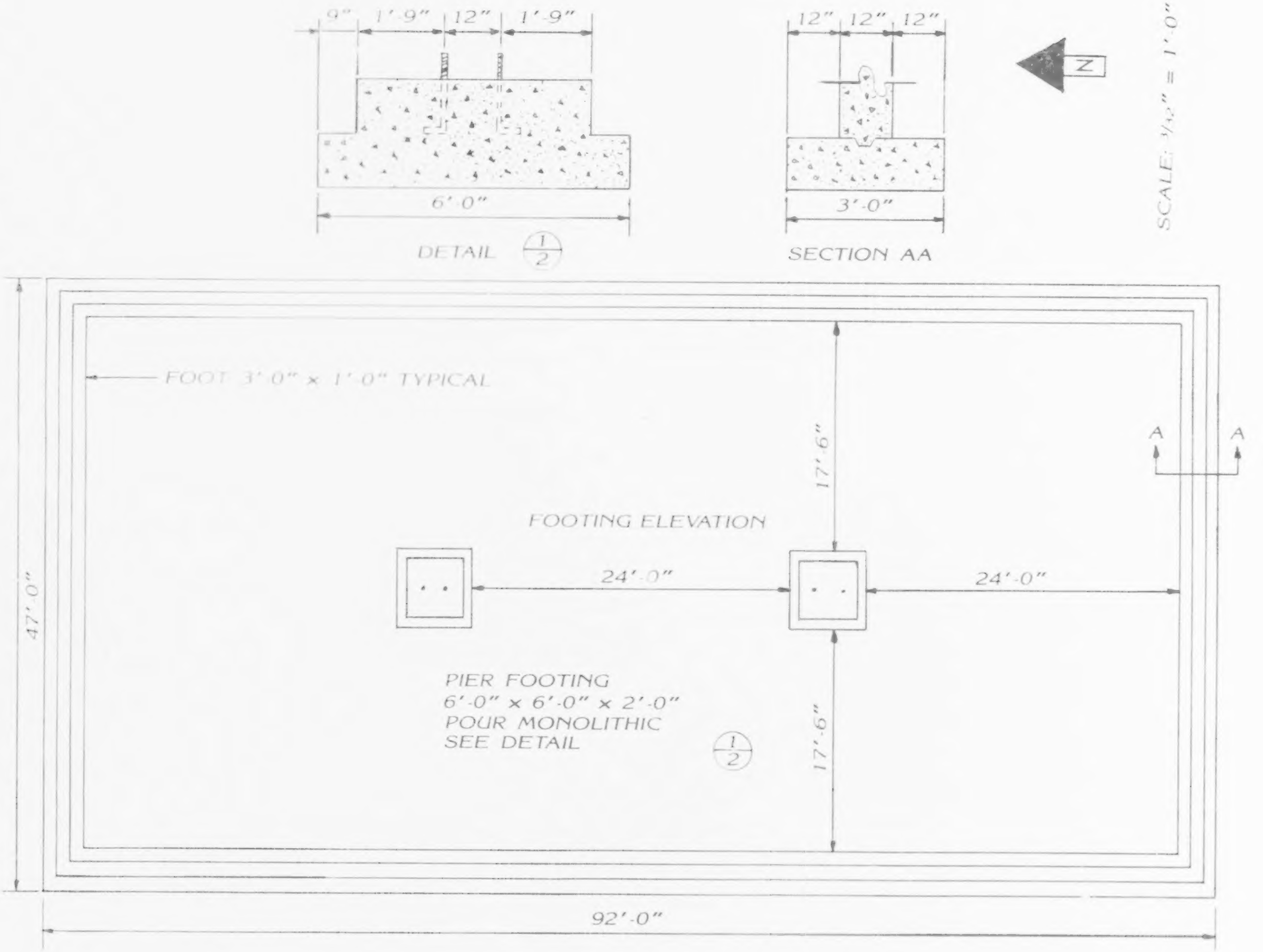

STILLWATER AVENUE
ELEVATION +100
N
24" STORM SEWER
MANHOLE COVER
UTILITY POLE
CURB
FIRE HYDRANT
10'-0"
MONUMENT
30'-0"
10'-0"
90'-0"
30'-0"
10'-0"
5'-0"
FIRST-FLOOR ELEVATION:
103'-6"
BASEMENT-FLOOR
ELEVATION: 89'-6"
45'-0"
PROPERTY LINE
90'-0"
SIDEWALK
SIXTH STREET
MONUMENT
15'-0"
PROPERTY LINE
130'-0"

SCALE: 1" = 20'-0"

PLOT PLAN

SHEET #1

JOB SHEET #1


9"
1'-9"
12"
1'-9"
6'-0"
DETAIL 1/2
12"
12"
12"
3'-0"
SECTION AA
N
SCALE: 3/32" = 1'-0"
FOOT 3'-0" × 1'-0" TYPICAL
A
A
17'-6"
FOOTING ELEVATION
24'-0"
24'-0"
47'-0"
PIER FOOTING
6'-0" × 6'-0" × 2'-0"
POUR MONOLITHIC
SEE DETAIL 1/2
17'-6"
92'-0"

FOUNDATION PLAN

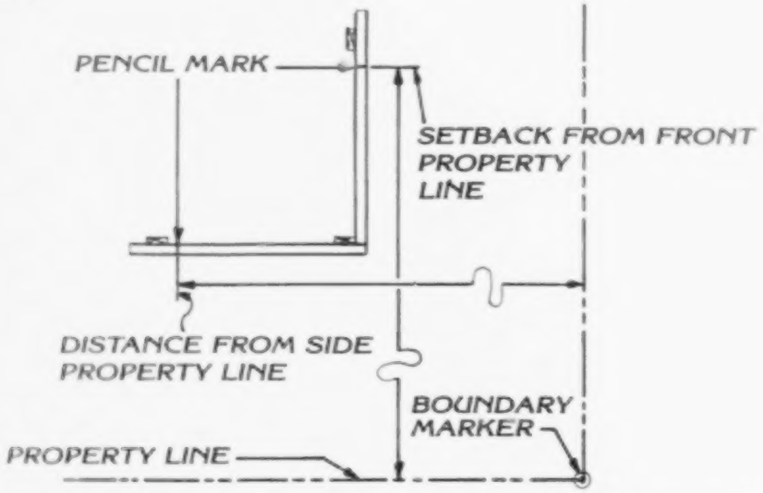
JOB SHEET #1

II. Procedure

A. Reestablish building lines

1. Measure from property line to ledger board on batter boards; mark top edge of ledger board at designated distance (Figure 14)

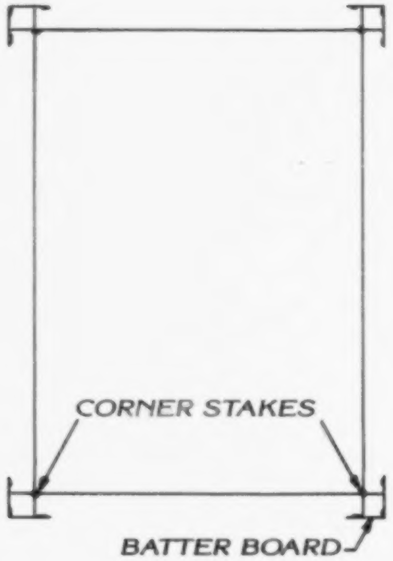
FIGURE 14


PENCIL MARK
SETBACK FROM FRONT PROPERTY LINE
DISTANCE FROM SIDE PROPERTY LINE
BOUNDARY MARKER
PROPERTY LINE

2. Continue this procedure until all building lines have been reestablished

3. Locate building lines by attaching string to nails driven into marks on ledger boards, and pulling string taut between these points (Figure 15)

FIGURE 15

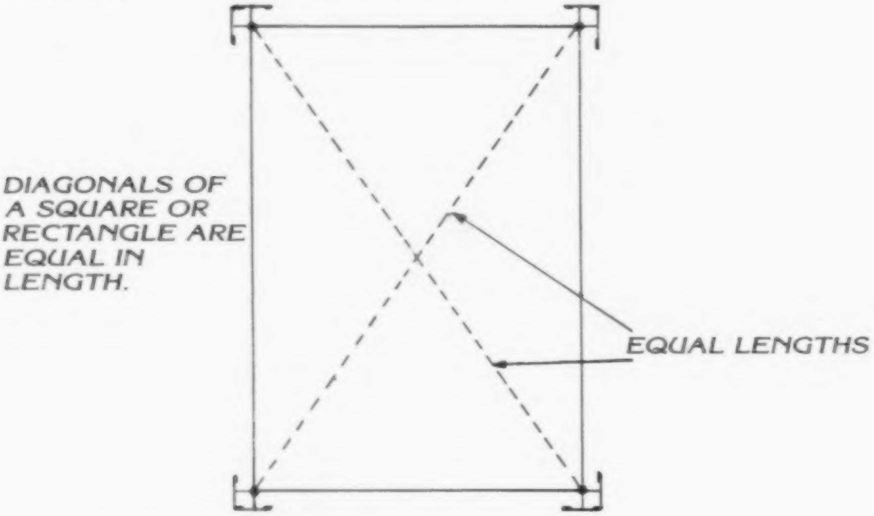

CORNER STAKES
BATTER BOARD

JOB SHEET #1

4. Square corners of building lines, using diagonal method or 3-4-5 method

   a. Diagonal method (Figure 16)

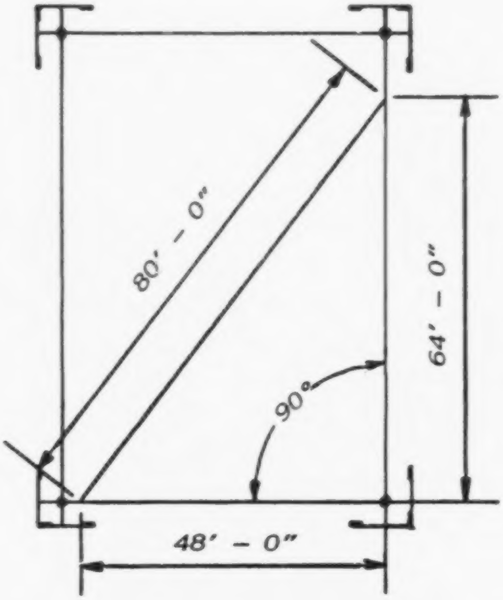
FIGURE 16


DIAGONALS OF A SQUARE OR RECTANGLE ARE EQUAL IN LENGTH.
EQUAL LENGTHS

   b. 3-4-5 method (Figure 17)

   (NOTE: Any multiple of 3-4-5 may be used, such as 6-8-10, 9-12-15, or 48-64-80.)

FIGURE 17


80' – 0"
64' – 0"
90°
48' – 0"

JOB SHEET #1

5. Shift strings on ledger boards until building-line corners are square

6. After exact building lines have been established and squared, saw a kerf or set a nail in each ledger board at the exact location to keep line from shifting

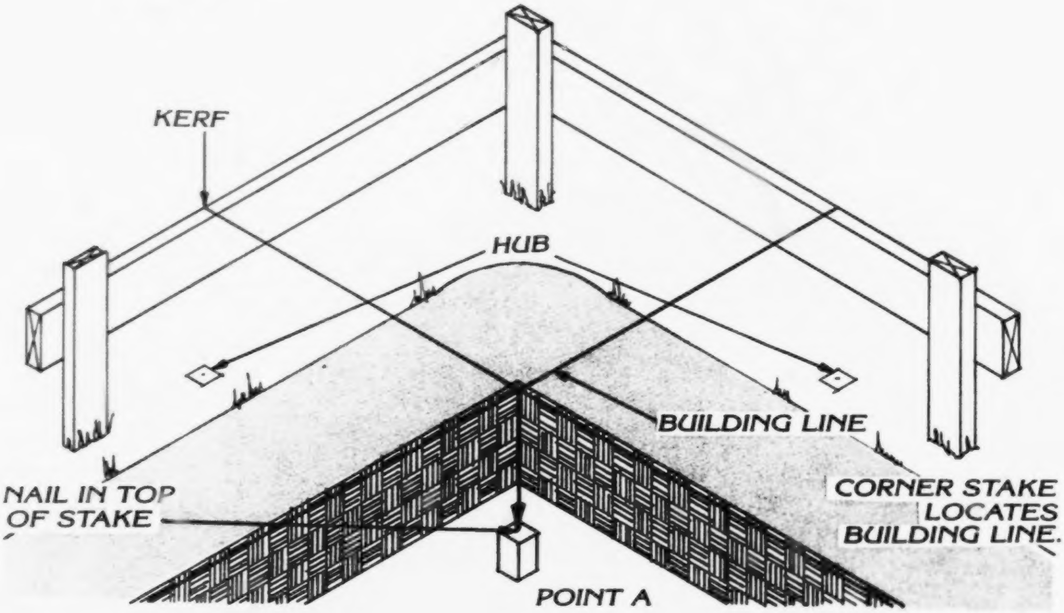
7. Locate and drive corner stakes at building lines to establish grade (See Figure 18)

   a. Plumb down from intersection of lines at each corner of building lines

   b. Drive corner stakes directly under plumb bob

   c. Drive a nail in top of each stake at exact point where plumb bob touches it; remove plumb bob

FIGURE 18



B. Transfer bench mark to bottom of excavation

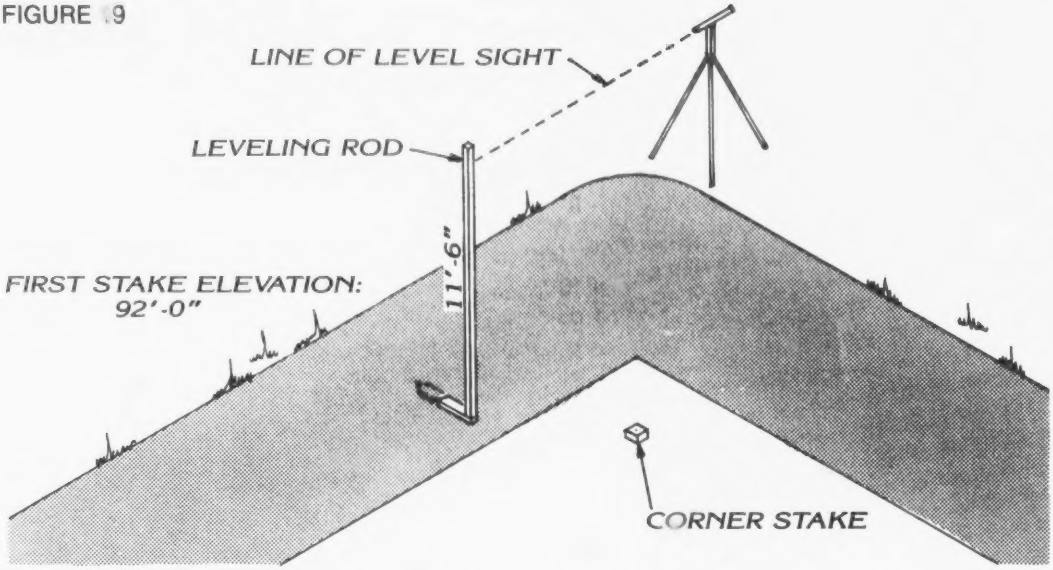
1. Set up builder's level

2. Establish height of instrument (HI) from bench mark; see Plot Plan, Sheet #1

   EXAMPLE: Assume an HI of 103'6"; from the plot plan, the basement-floor elevation is 89'6" from 103'6", which is 14'0"; this is the figure to read on the leveling rod; however, the rod is only 12' long, so drive a stake in the bank reading 11'6" on the leveling rod; this will be at elevation 92'0" (See Figure 19).

JOB SHEET #1

FIGURE 19


LINE OF LEVEL SIGHT
LEVELING ROD
11'-6"
FIRST STAKE ELEVATION:
92'-0"
CORNER STAKE

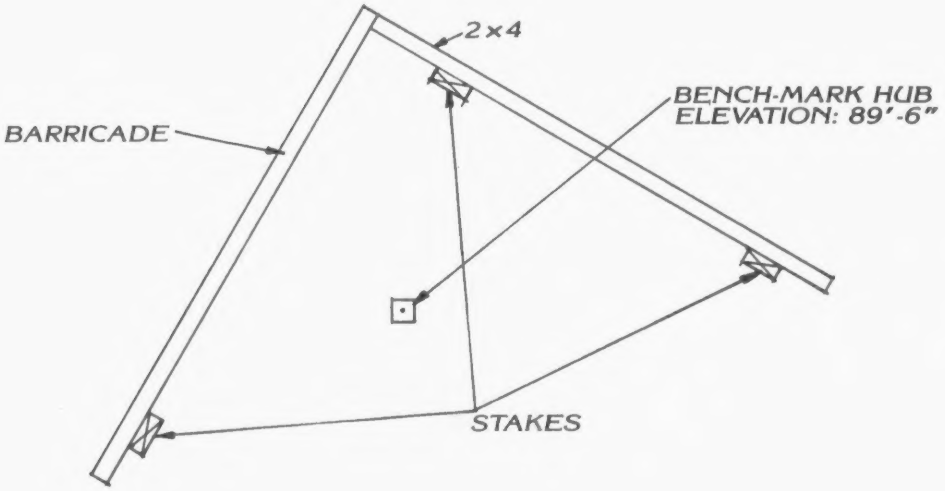
3. Move builder's level to bottom of excavation and set it up

4. Pick up HI from stake at elevation on leveling rod and set another hub stake, with top of stake at basement-floor elevation

   (NOTE: The bench-mark hub should be placed in a central location and out of the areas of traffic. Build a barricade around it if necessary. See Figure 20.)

5. Set all corner stakes at bench-mark elevation (Figure 20)

FIGURE 20


2×4
BENCH-MARK HUB
ELEVATION: 89'-6"
BARRICADE
STAKES

JOB SHEET #1

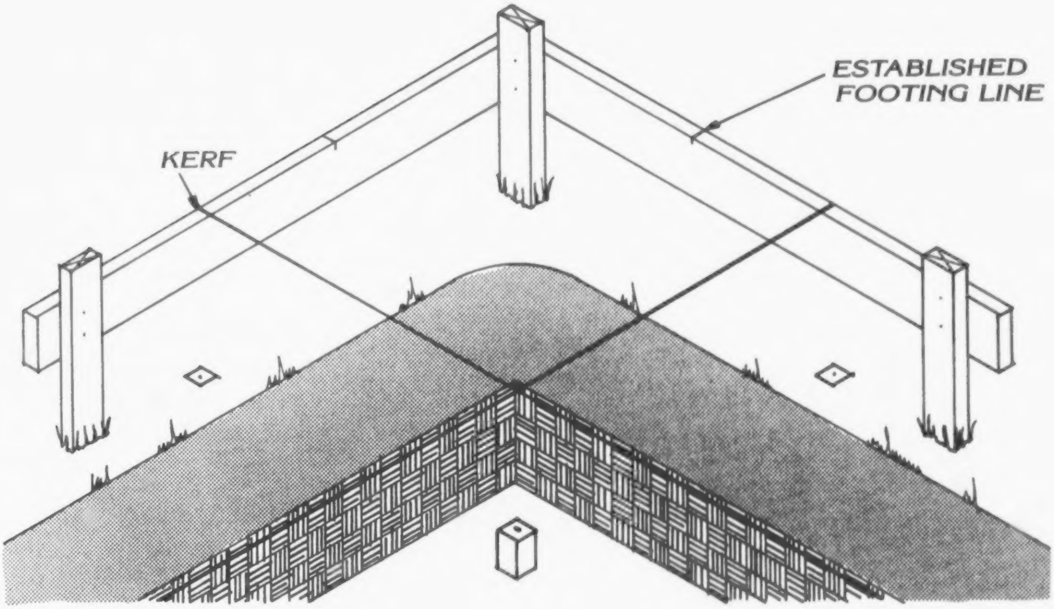
C. Establish footing lines

1. Determine from plans how far outside of building lines to construct forms

   (NOTE: Since the footings are 3 feet wide and the finished walls are 1-foot thick, the footing lines will have to be set 12 inches both ways from the building line, plus another 1½ inches to allow for the thickness of the forms.)

2. Measure over 13½ inches from each kerf in ledger boards; mark top edges of ledger boards at this point to establish outside footing lines (Figure 21)

FIGURE 21



3. Drive a nail at these locations to help distinguish footing line from building line

4. Move string line from building line and stretch from one footing-line nail to the next, continuing around outside footing of proposed building

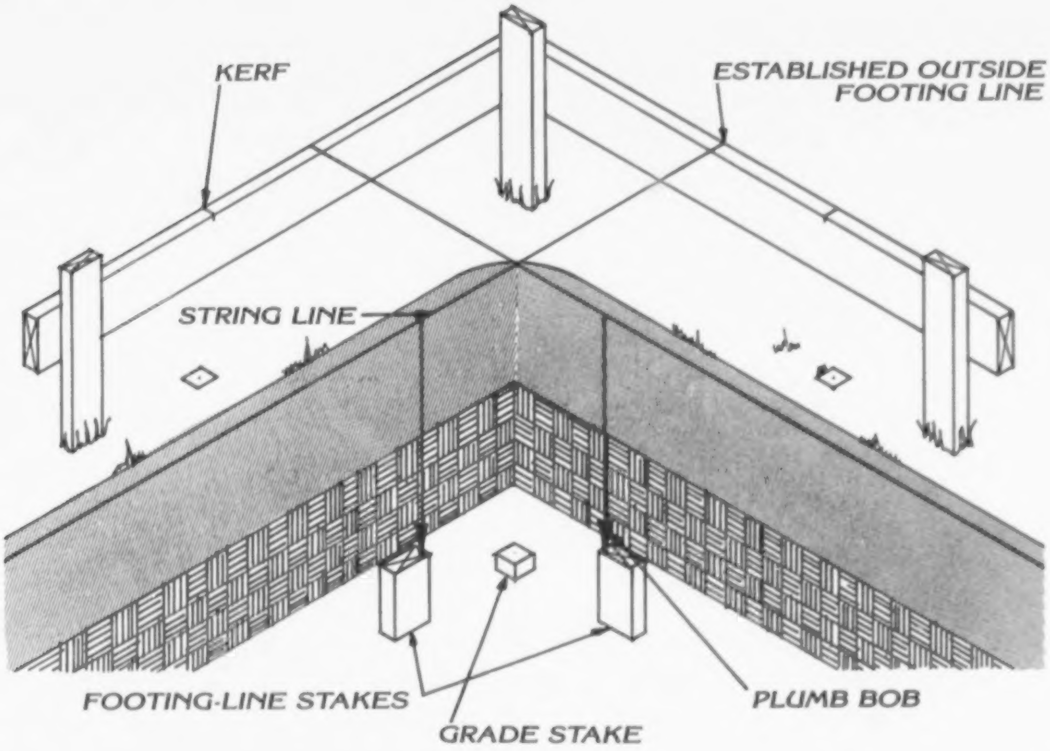
D. Set outside forms

(NOTE: Refer to the plans when necessary to check dimensions.)

JOB SHEET #1

1. Use plumb bob to locate position of footing-line stakes for each corner of building (Figure 22)

FIGURE 22


KERF
ESTABLISHED OUTSIDE FOOTING LINE
STRING LINE
FOOTING-LINE STAKES
PLUMB BOB
GRADE STAKE

2. Move plumb bob; drive stakes straight, leaving them a little higher than bench-mark hub stakes

3. Recheck stakes with plumb bob after they are set

4. Transfer grade from grade stakes to outside footing-line stakes

5. Attach line to stakes

6. String line from one line stake to one on opposite end of footing, centering line on the grade that was transferred to those stakes

7. Lay out forms end to end along the proposed footing line

8. Drive all outside footing stakes, spacing them approximately 4 feet apart

JOB SHEET #1

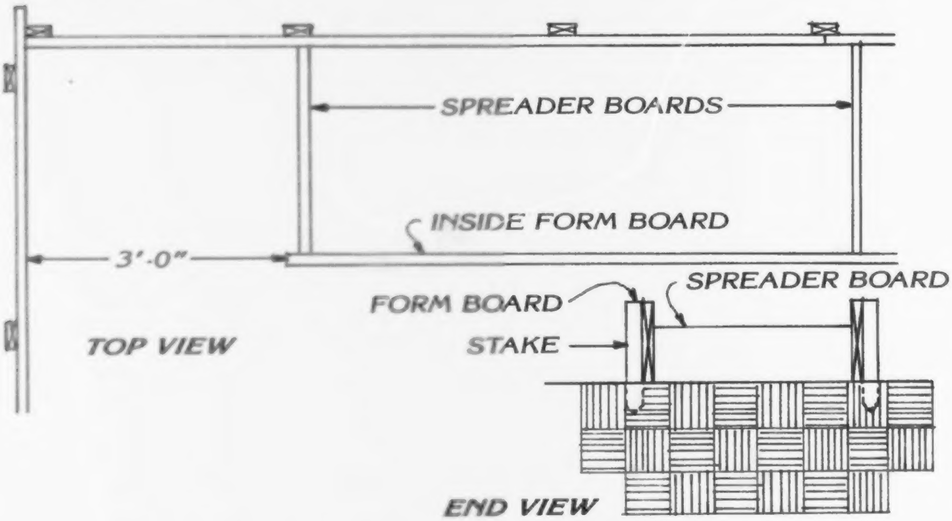
9. Nail form boards to grade, checking alignment of boards by using plumb bob attached at different points on string line

E. Set inside forms

1. Set spreader boards on edge against outside forms, and then set inside form boards against spreader boards (Figure 23)

   (NOTE: Form oil must be applied either before or after installation.)

FIGURE 23



2. Set inside footing-form stakes, spacing them approximately 4 feet apart and driving them straight down so that there is no pressure exerted against inside form, which would move outside form out of line

3. Nail inside form boards to grade, checking alignment of boards by using plumb bob attached at different points along string line

4. Nail cleats across top of form (See Figure 24)

5. Install dowel rods if specified in the plans

   a. Nail 2×4 across cleats to support dowel rods

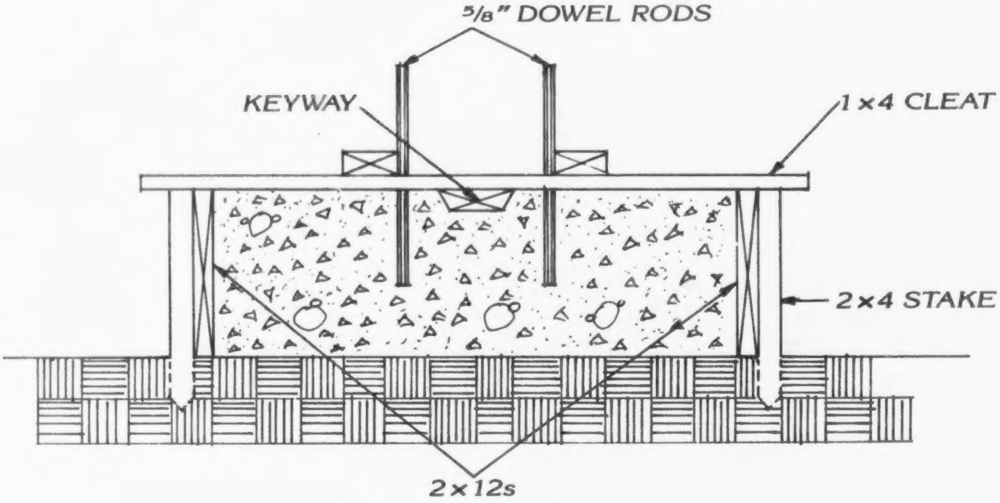
   b. Fasten dowels to 2×4

   c. Nail keyway to cleats if specified (See Figure 24)

      (NOTE: For ease of placing concrete, dowels and keyway may be installed after concrete is in place.)

JOB SHEET #1

FIGURE 24


5/8" DOWEL RODS
KEYWAY
1 x 4 CLEAT
2 x 4 STAKE
2 x 12s

F. Recheck forms for alignment

(NOTE: The tops of the stakes may be cut off flush with the top of the form for ease of finishing the surface of the concrete.)

G. Clean up area and put away tools and materials

FOOTING AND FOUNDATION FORMS
UNIT I

JOB SHEET #2 — CONSTRUCT AND SET FORMS FOR A PIER FOOTING

I. Tools and materials

  A. Tools

    1. Power handsaw and extension cord
    2. Crosscut handsaw
    3. Claw hammer
    4. Sledgehammer
    5. One-hundred foot tape
    6. Folding rule or steel tape
    7. Hand level
    8. Builder's level
    9. Power drill motor and drills
    10. Chalk line
    11. Ten-inch adjustable wrench
    12. String line or wire
    13. Plumb bob
    14. Framing square
    15. Large brush, spray can, roller, or mop for applying form oil

  B. Materials

    1. Stakes
    2. Sheathing
      a. 3/4-inch plywood
      b. 2×10s
    3. Spreaders

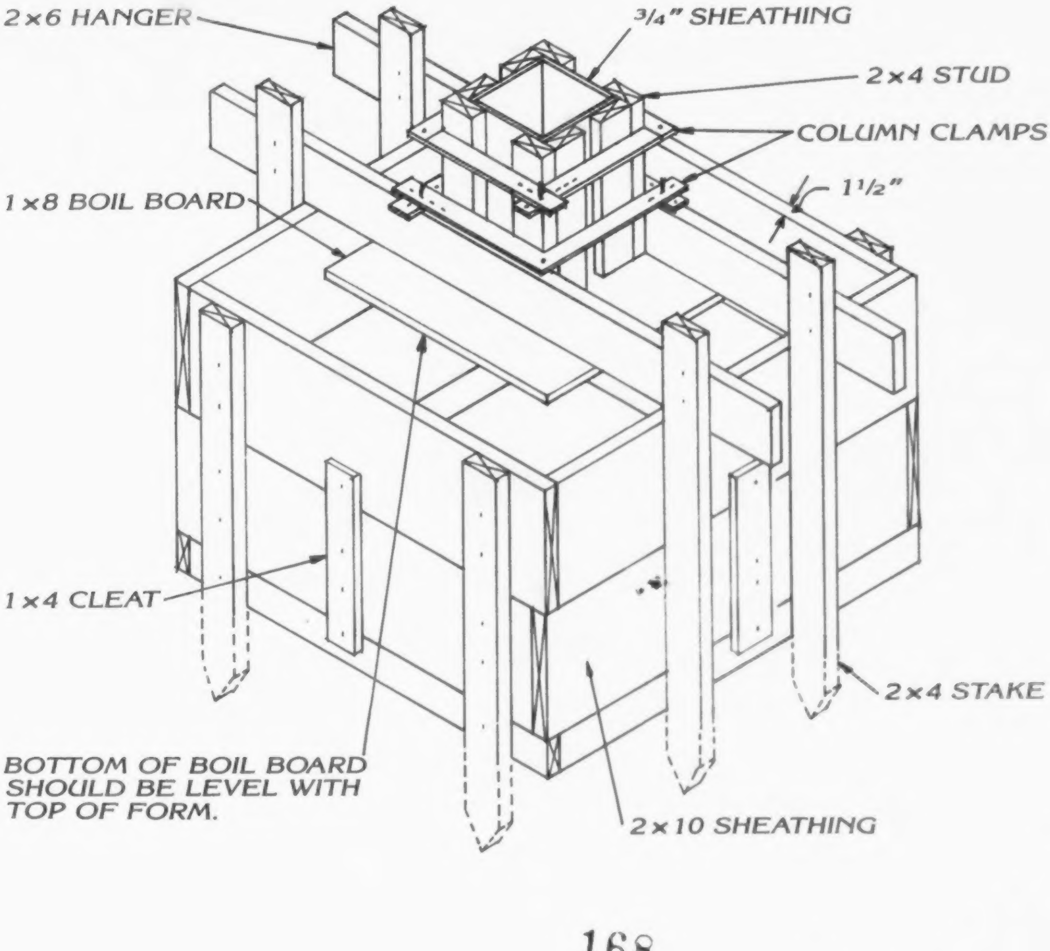
JOB SHEET #2

4. Form ties
5. 2×4s or 2×6s for braces, studs, and hanger
6. 1×4s for cleats
7. 8d and 16d duplex nails
8. 6d, 8d, and 16d common nails
9. Form oil
10. Column clamps

II. Procedure

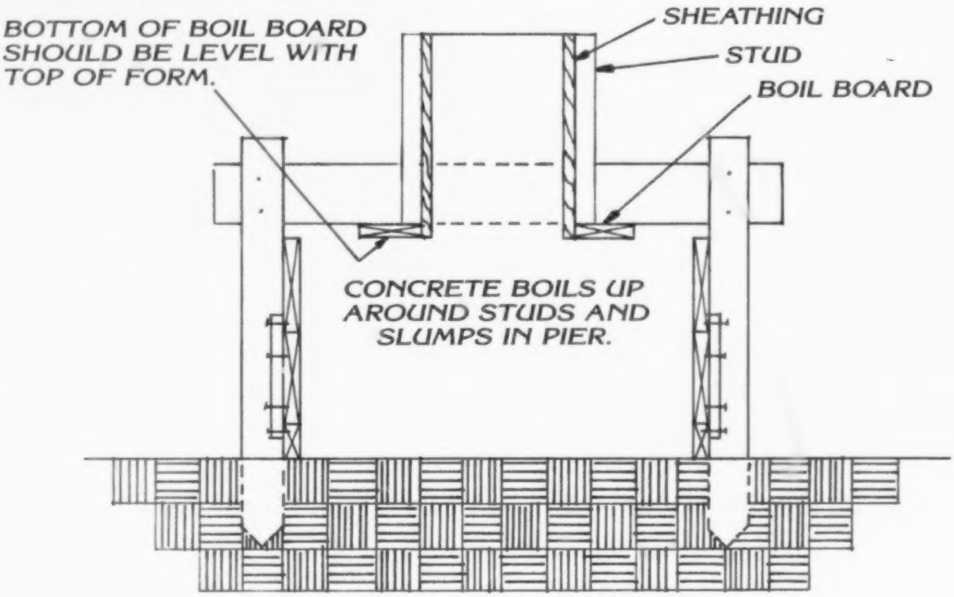
A. Consult with your instructor to determine the size of form (Figures 25 and 26)

FIGURE 25


2×6 HANGER
3/4" SHEATHING
2×4 STUD
COLUMN CLAMPS
1 1/2"
1×8 BOIL BOARD
1×4 CLEAT
2×4 STAKE
BOTTOM OF BOIL BOARD SHOULD BE LEVEL WITH TOP OF FORM.
2×10 SHEATHING

JOB SHEET #2

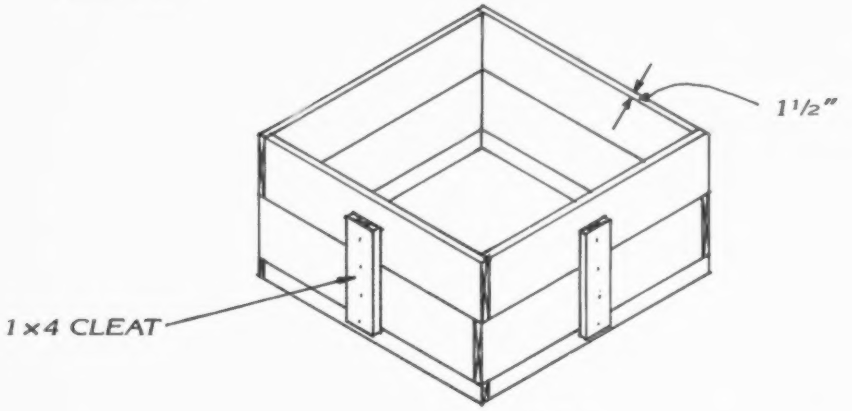
FIGURE 26


BOTTOM OF BOIL BOARD SHOULD BE LEVEL WITH TOP OF FORM.
SHEATHING
STUD
BOIL BOARD
CONCRETE BOILS UP AROUND STUDS AND SLUMPS IN PIER.

B. Build forms

1. Make a material cut list
2. Cut material to size, using material cut list
3. Build bottom form (Figure 27)

FIGURE 27


$1\frac{1}{2}''$
1 x 4 CLEAT

JOB SHEET #2

4. Build pier-form panels (Figures 28 and 29)

FIGURE 28

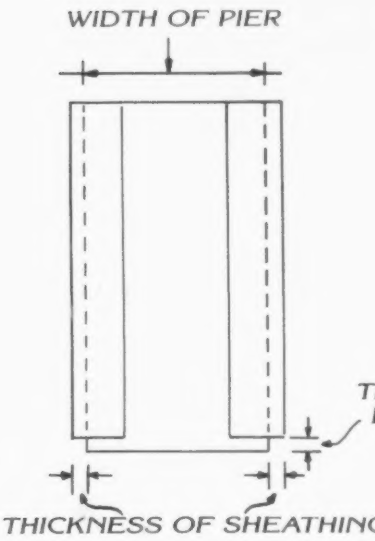
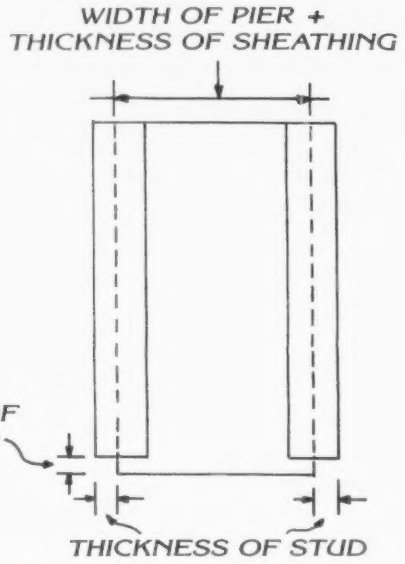

WIDTH OF PIER
THICKNESS OF BOIL BOARD
THICKNESS OF SHEATHING

FIGURE 29


WIDTH OF PIER + THICKNESS OF SHEATHING
THICKNESS OF BOIL BOARD
THICKNESS OF STUD

5. Nail panels together (Figures 30 and 31)

FIGURE 30

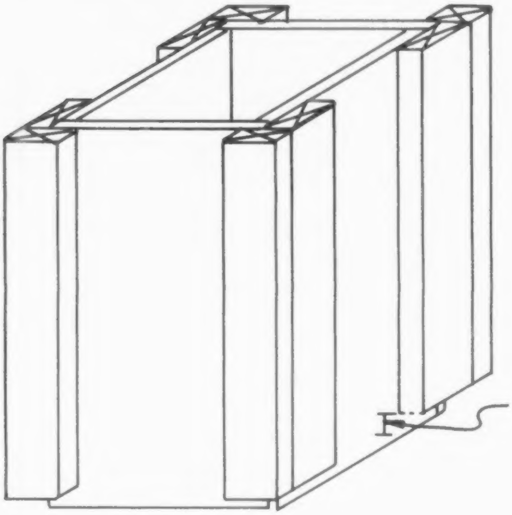
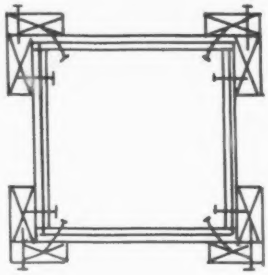

THICKNESS OF BOIL BOARD

FIGURE 31: Top view

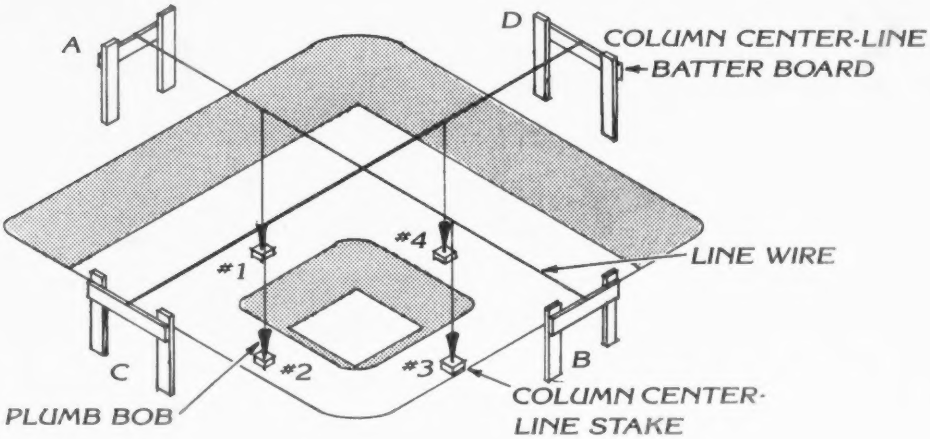


JOB SHEET #2

6. Coat both forms with form oil

C. Locate and set column center-line stakes (Figure 32)

FIGURE 32


A
D
COLUMN CENTER-LINE
BATTER BOARD
#4
#1
LINE WIRE
C
#2
#3
B
COLUMN CENTER-
LINE STAKE
PLUMB BOB

1. Stretch lines between points AB and points CD

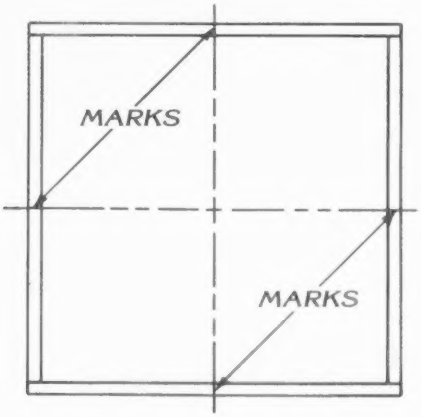
2. Use plumb bob to establish center-line stakes #1, #2, #3, and #4

D. Set the form

1. Set bottom form section in excavation

2. Mark center line on all four sides of form (Figure 33)

FIGURE 33


MARKS
MARKS

JOB SHEET #2

3. Stretch lines between stakes AB and stakes CD; pull taut (See Figure 34)

4. Locate form with center-line marks directly under column center lines, using plumb bob or hand level (Figures 34 and 35)

FIGURE 34

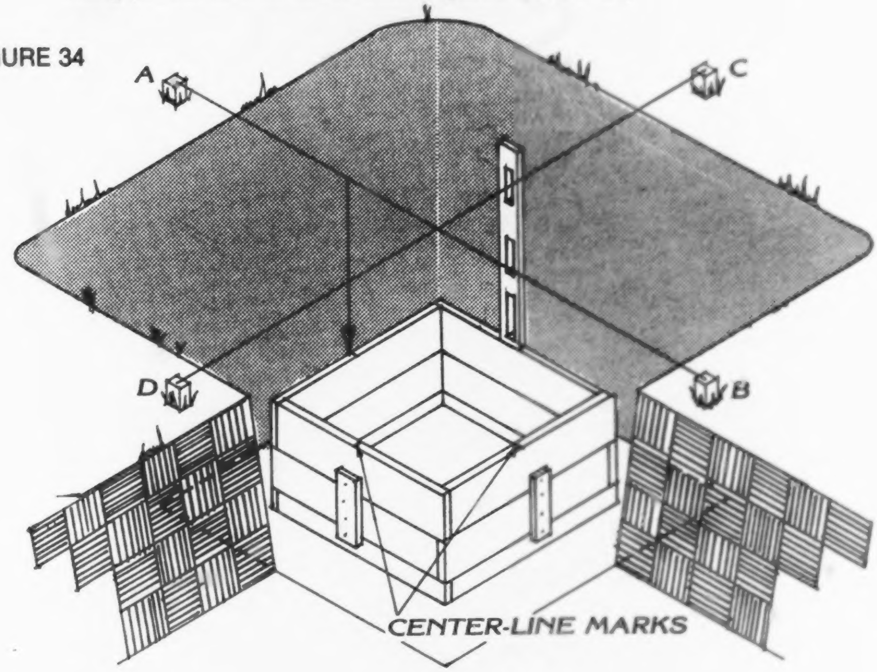
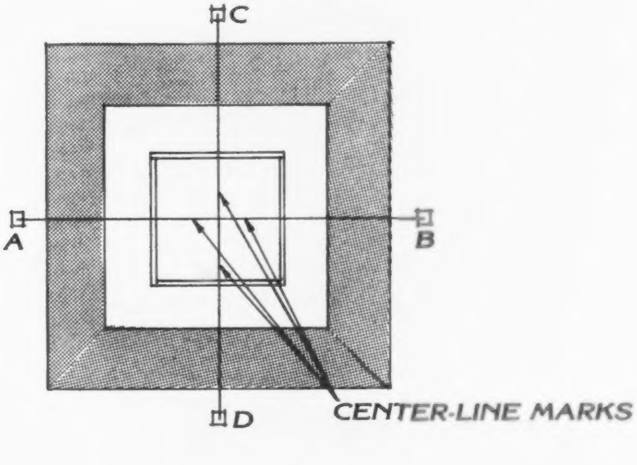

A
C
D
B
CENTER-LINE MARKS

FIGURE 35


C
A
B
D
CENTER-LINE MARKS

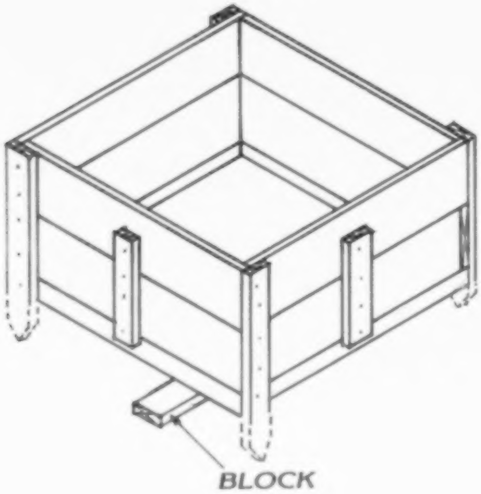
5. Drive stakes at four corners of form

JOB SHEET #2

6. Use builder's level and leveling rod to establish grade from bench mark to corners of form

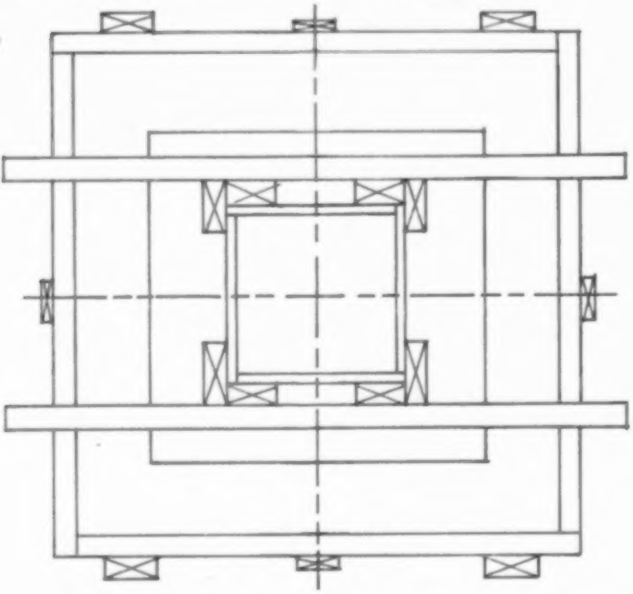
7. Block form up to grade and nail to stakes (Figure 36)

FIGURE 36



8. Turn pier panel upside down and install boil boards and hangers, installing hangers parallel to short boil boards (Figure 37)

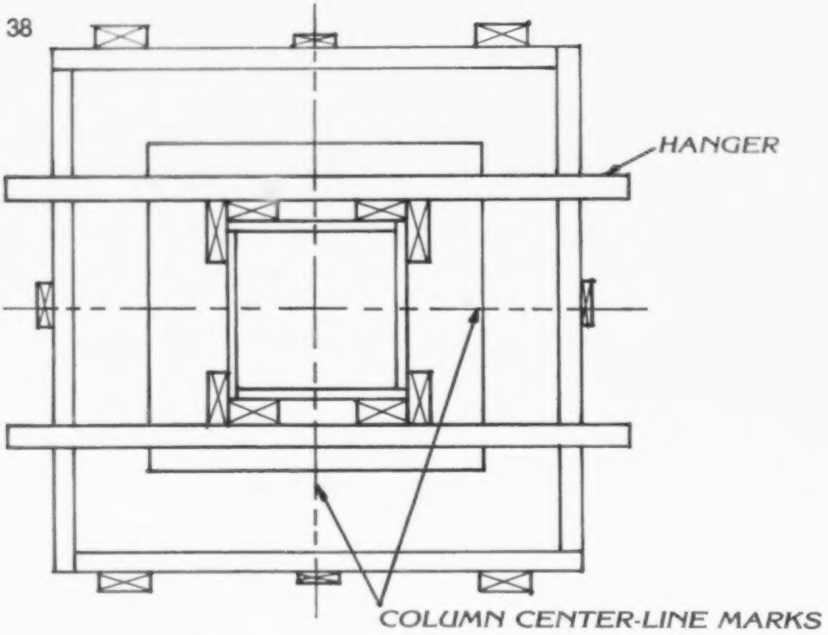
FIGURE 37



9. Set pier form on bottom form and position it approximately on column center-line marks (See Figure 38)

JOB SHEET #2

FIGURE 38


HANGER
COLUMN CENTER-LINE MARKS

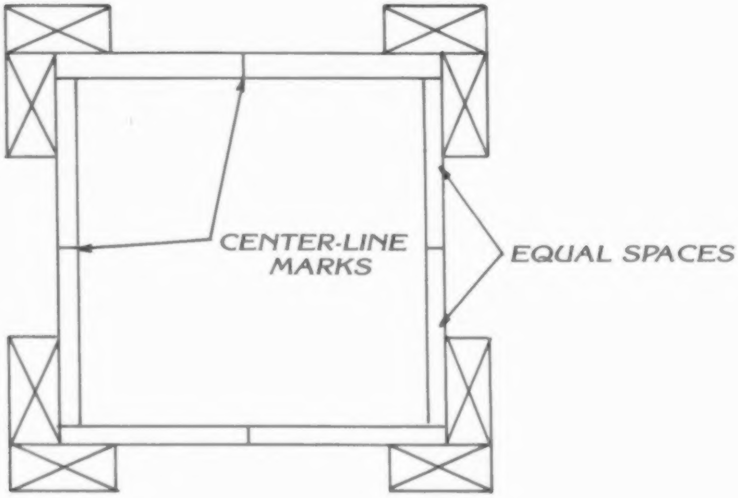
a. Raise hangers

b. Place a block between pier form and bottom form at the four points on which hangers sit

c. Tack block in place

10. Mark centers of pier form sides on top of sheathing (Figure 39)

FIGURE 39


CENTER-LINE MARKS
EQUAL SPACES

JOB SHEET #2

11. Plumb down from column center line to marks on top of pier

12. Nail hangers to bottom form

13. Drive stakes along sides of form and hanger

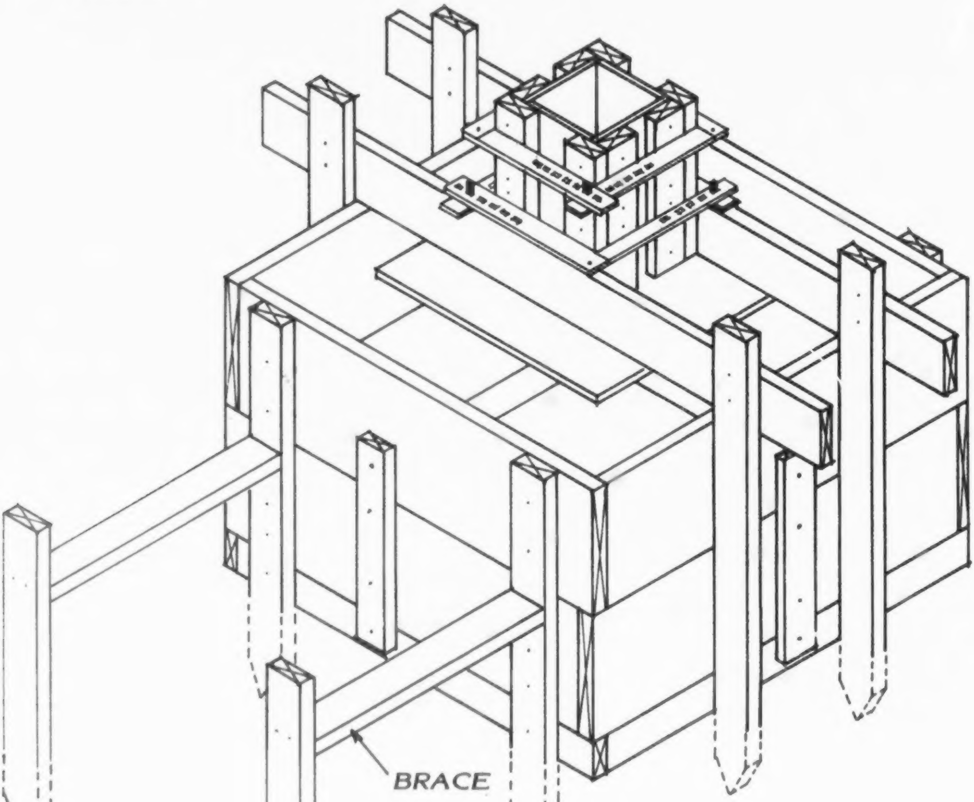
14. Check alignment of pier; if pier is still aligned, nail stakes to hangers (See Figure 40)

15. Install column clamps, positioning one on top of hanger and one 6 inches from top of pier form (See Figure 40)

    (NOTE: If piers are over 2 feet high, more clamps will be needed.)

16. Brace or use kicker on bottom form (Figure 40)

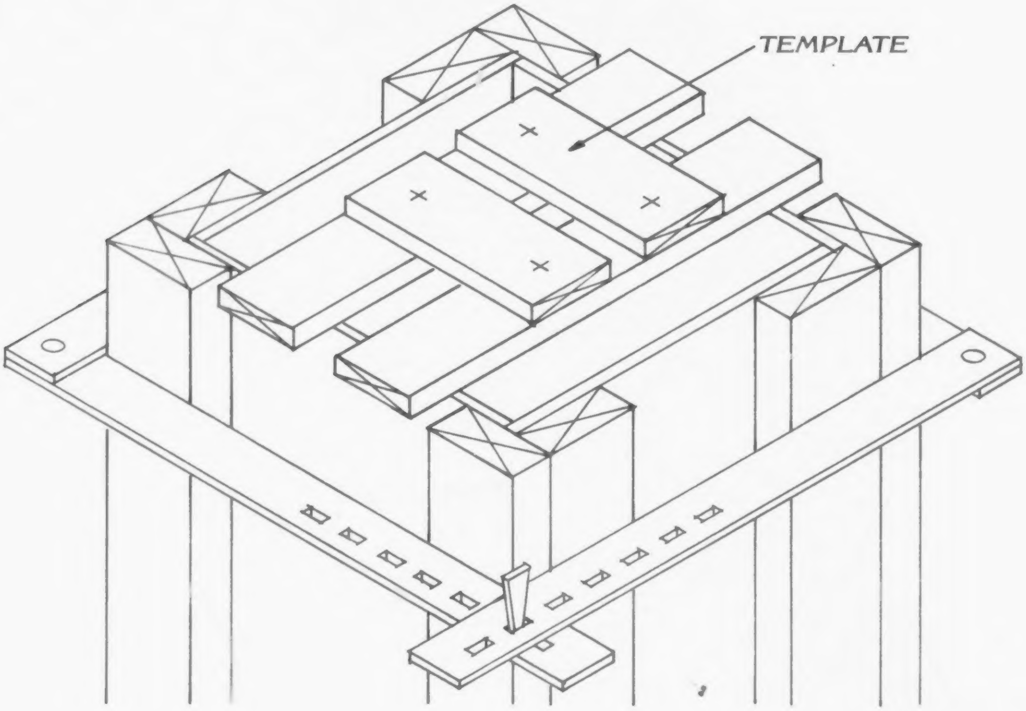
FIGURE 40



JOB SHEET #2

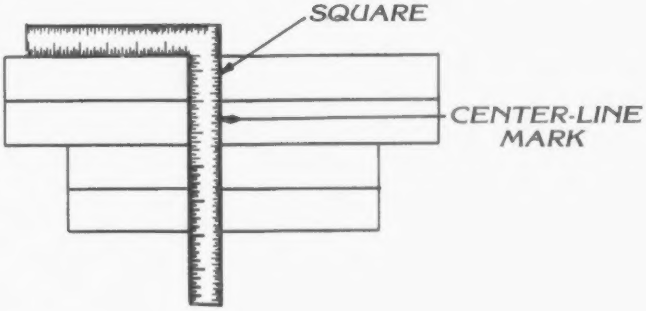
E. Build and set bolt template (Figure 41)

FIGURE 41



1. Cut two pieces of 1×4 long enough to reach across top of pier form
2. Cut two 1×4 pieces 3 inches longer than center-line spacing of bolts
3. Align the four pieces as shown in Figure 42 and make a center-line mark across them

FIGURE 42

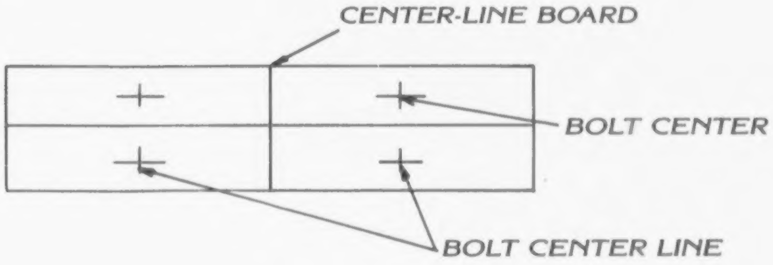

SQUARE
CENTER-LINE MARK

JOB SHEET #2

4. Lay out bolt spacing on the length of the two short boards; cross these lines with a center-line mark on the width (Figure 43)

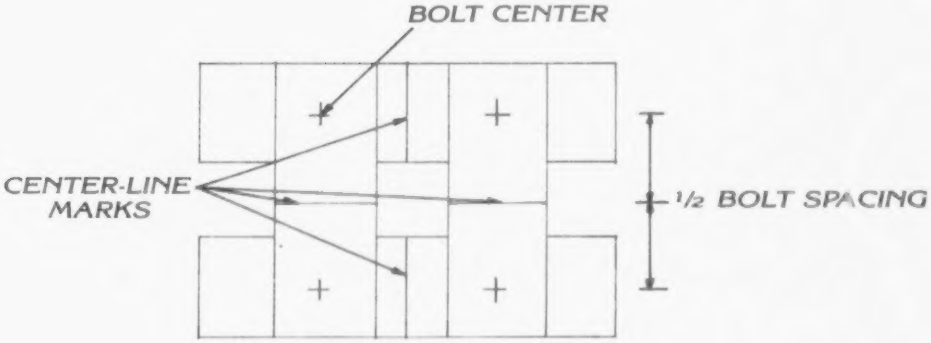
   (NOTE: Accuracy is of the utmost importance in all bolt layouts.)

FIGURE 43


CENTER-LINE BOARD
BOLT CENTER
BOLT CENTER LINE

5. Nail the four pieces together as shown in Figure 44, checking template for square and bolt centers for distance before nailing securely

FIGURE 44


BOLT CENTER
CENTER-LINE MARKS
$\frac{1}{2}$ BOLT SPACING

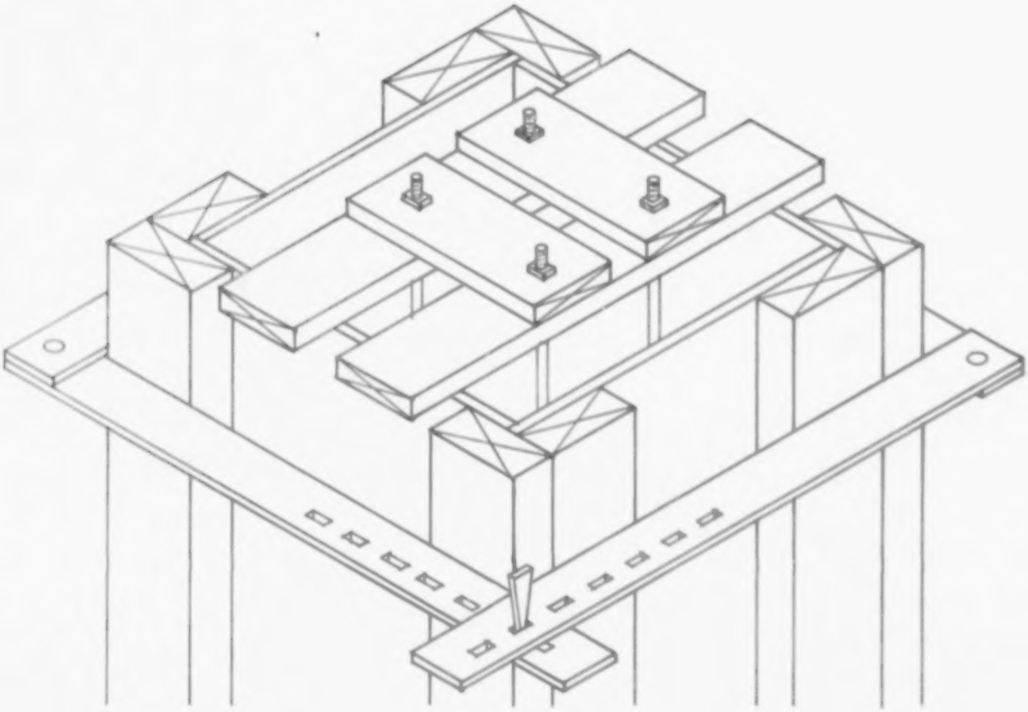
6. Drill holes, not more than $^1/_{16}$-inch larger than bolt, at crosses marking bolt centers

7. Set template on pier form, using a square to locate it on the column center lines; nail securely to form (See Figure 45)

   (NOTE: Recheck bolts for location and plumb after concrete is poured.)

JOB SHEET #2

FIGURE 45



F. Clean up work area and put away tools and materials

FOOTING AND FOUNDATION FORMS
UNIT I

JOB SHEET #3 — STRIP PIER-FOOTING FORMS AND PREPARE FORMS FOR ERECTION AT ANOTHER LOCATION

I. Tools and materials

A. Wrecking bar

B. Claw hammer

C. Large brush, spray can, roller, or mop for applying form oil

II. Procedure

A. Strip forms

(NOTE: Forms are stripped in the reverse order of setting.)

1. Remove pier form, taking care not to damage the form parts any more than necessary so that they may be reused

a. Remove column clamps or hangers

b. Remove duplex nails from two corners of form

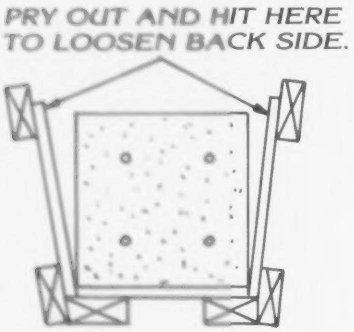
c. Pry this side from pier

CAUTION

Do not pry against green concrete.

d. Remove remaining three sides as one unit (Figure 46)

FIGURE 46



JOB SHEET #3

   2. Remove all nails from braces, kickers, and cleats
   3. Remove braces, kickers, and cleats
   4. Remove duplex nails from one corner of bottom forms
   5. Spread form apart at this corner and remove in one unit

B. Prepare forms for erection at next location

   1. Renail single pier panel to three panel sections, and replace boil board if it was damaged
   2. Attach hangers
   3. Renail corners of bottom form sections
   4. Coat inside of forms with form oil
   5. Transport all form parts to next location

C. Clean up work area and put away tools and materials

FOOTING AND FOUNDATION FORMS
UNIT I

TEST

NAME ________________________________ SCORE ____________

1. Match to their correct definitions terms associated with footing and foundation forms. Write the correct numbers in the blanks.

______a. Paraffin product or other manufactured product used on forms to prevent adhesion of concrete to form

______b. Any solid masonry support

______c. Steel bar inserted into concrete to help tie adjoining concrete together

______d. Deformed steel bar used to strengthen concrete

______e. Board placed in a form to cut off concrete pour

______f. Enlarged area at base of foundation designed to distribute weight of superstructure

______g. Substructure below first-floor construction or grade, including footing; supports the structure

______h. Finish level of concrete in a form

______i. Depth, in feet, of concrete poured in one hour

______j. Wide board placed around bottom of form to prevent concrete from rising up around form

______k. Temporary structure or mold for the support of concrete while it is setting in a desired shape and gaining sufficient strength to be self-supporting

______l. Thin blade or board frame used as a guide in positioning form parts

______m. Right-angled column or pillar projection from a pier or wall

1. Form
2. Footing
3. Foundation
4. Form oil
5. Bulkhead
6. Rate of pour
7. Boil board
8. Pier
9. Pilaster
10. Dowel rod
11. Reinforcing bar (rebar)
12. Template
13. Grade point

2. Discuss external factors that affect form design.

a. Amount of pressure to be placed on form

____

____

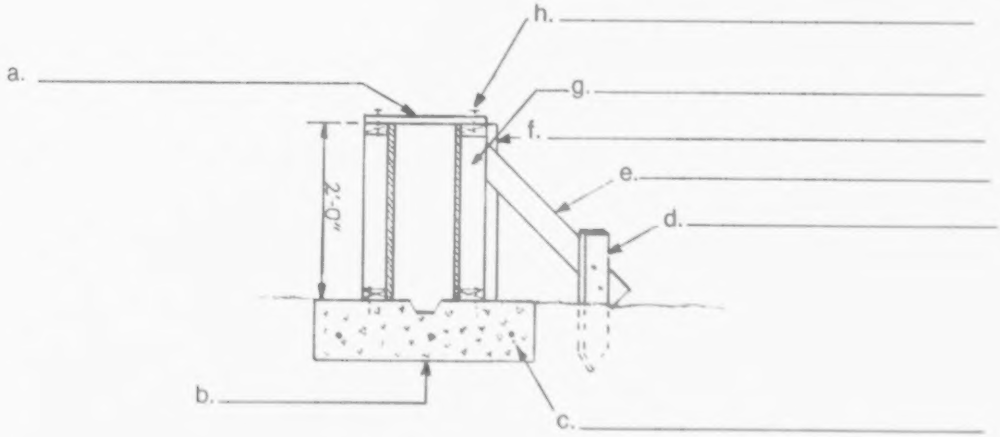
____

b. Length of time pressure is to remain on form

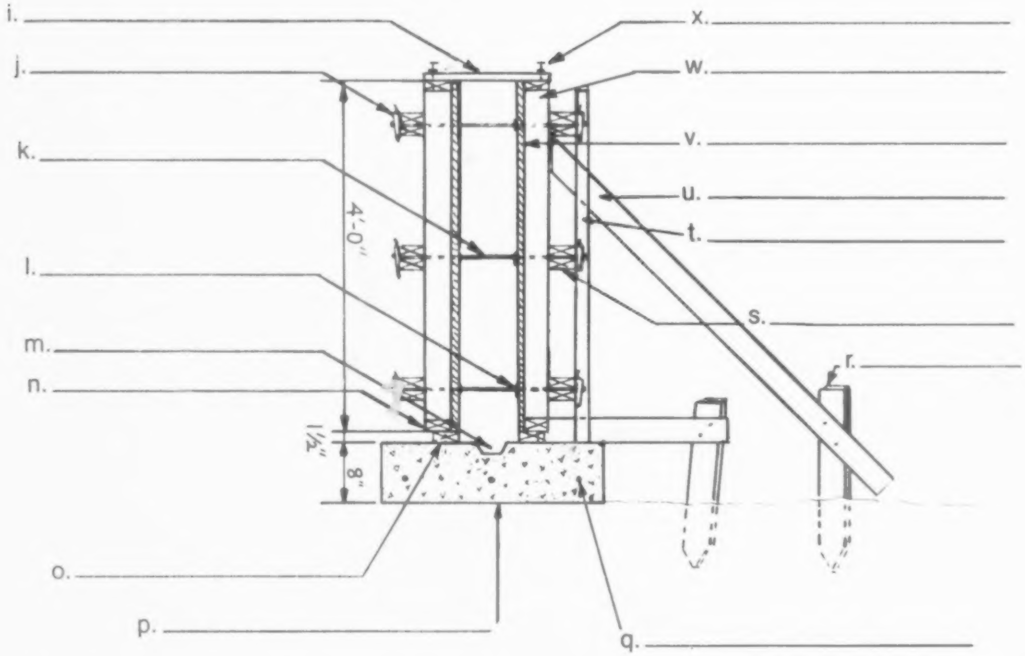
c. Type of concrete finish

3. Identify the parts of the form in the illustrations below and on the next page. Write the correct names in the blanks. Some answers will be used more than once.

Cleat
Keyway
Reinforcing steel
Brace
Form-tie clamp
Bottom plate
Stake
Sheathing
Panel
Form tie
Soleplate
Waler
Stud
Spreader washer
Footing
Strongback
Duplex nail

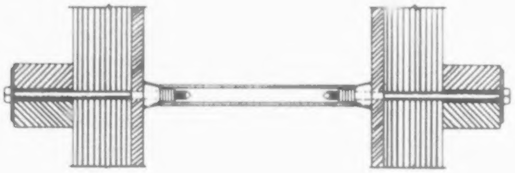


TEST



4. Identify the types of form ties and clamps illustrated below and on the next pages. Write the correct names in the blanks.

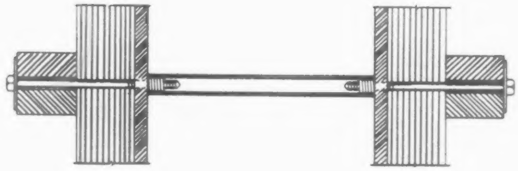
She-bolt assembly
Threaded-rod wall-tie assembly
Coil tie with separate spreader
Wall-tie clamp
Waterseal coil tie
Coil tie as spreader and tie
Wall-tie assembly
Coil tie with spreader cone
Form clamps (buttons) used with plan, round, mild-steel rods



a. ______________________________

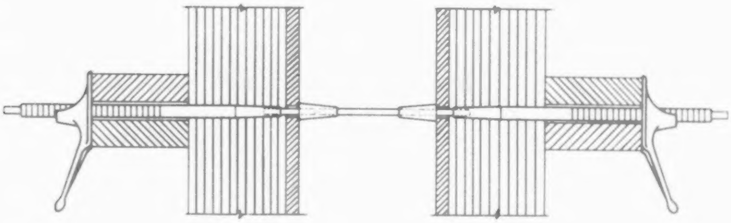
____

TEST



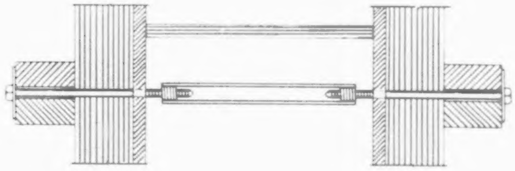
b. ______________________________

____



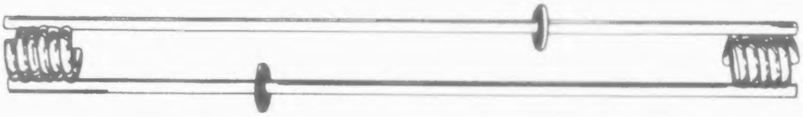
c. ______________________________

____



d. ______________________________

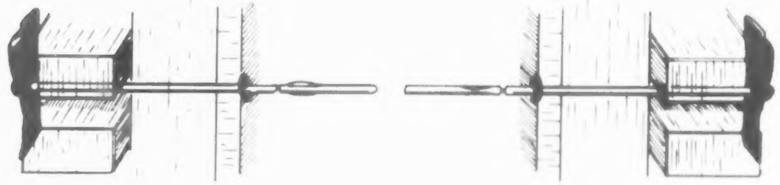
____



e. ______________________________

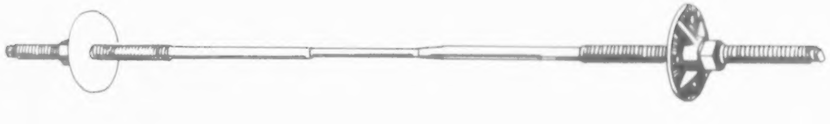
____

TEST



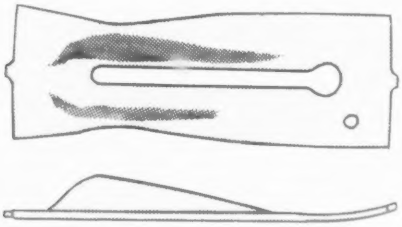
f. ______________________________

____



g. ______________________________

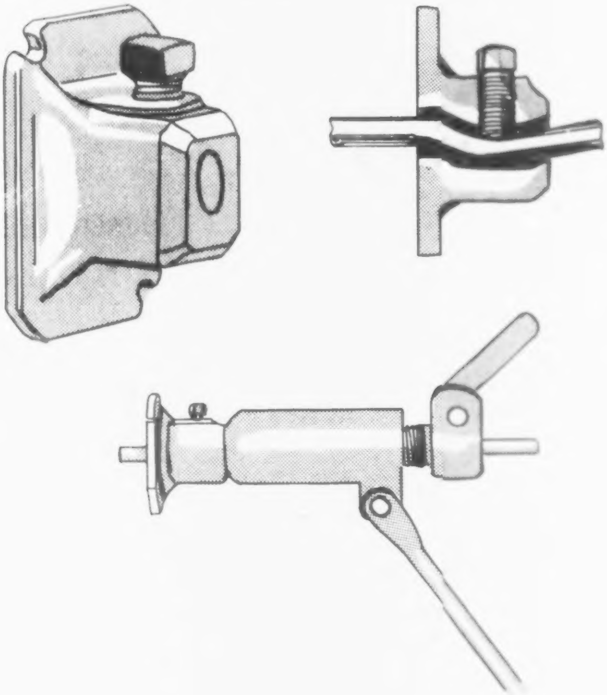
____



h. ______________________________

____

TEST



i. ______________________________

____

5. Name methods of form construction for footings.

    a. ____

    b. ____

(NOTE: Test question 6 lists the job sheets. They are an important part of the test. If they have not been completed, check with your instructor.)

6. Demonstrate the ability to

    a. Set forms for a continuous footing.

    b. Construct and set forms for a pier footing.

    c. Strip pier-footing forms and prepare forms for erection at another location.

FOOTING AND FOUNDATION FORMS
UNIT I

ANSWERS TO TEST

1. a. 4
   b. 8
   c. 10
   d. 11
   e. 5
   f. 2
   g. 3
   h. 13
   i. 6
   j. 7
   k. 1
   l. 12
   m. 9

2. Discussion should include the following

   a. Amount of pressure to be placed on form

      1) Rate of pour — The faster the rate of pour, the greater the pressure exerted
      2) Vibration — Power vibration can cause pressure to increase as much as 35 percent
      3) Method of placement — The greater the height of the drop and the mass of concrete, the greater the pressure increase

   b. Length of time pressure is to remain on form

      1) Slump — The greater the slump, the longer it takes concrete to set, causing pressure to remain on the form for a longer period of time
      2) Temperature — The higher the temperature, the faster concrete sets

   c. Type of concrete finish

      1) Architectural concrete — Is exposed in finished structure, thus requires forms designed to give minimum deflection and leakage
      2) Structural concrete — Is not exposed in finished structure, thus allows form design that permits some deflection and leakage

3. a. Cleat
   b. Footing
   c. Reinforcing steel
   d. Stake
   e. Brace
   f. Strongback
   g. Panel
   h. Duplex nail
   i. Cleat
   j. Form-tie clamp
   k. Form tie
   l. Spreader washer
   m. Keyway
   n. Bottom plate
   o. Soleplate
   p. Footing
   q. Reinforcing steel
   r. Stake
   s. Waler
   t. Strongback
   u. Brace
   v. Sheathing
   w. Stud
   x. Duplex nail

ANSWERS TO TEST

4. a. Coil tie with spreader cone
   b. Coil tie as spreader and tie
   c. Threaded-rod wall-tie assembly
   d. Coil tie with separate spreader
   e. Waterseal coil tie
   f. Wall-tie assembly
   g. She-bolt assembly
   h. Wall-tie clamp
   i. Form clamps (buttons) used with plain, round, mild-steel rods

5. a. Built on site
   b. Prefabricated, patented

6. Performance skills completed to the satisfaction of the instructor

EDGE FORMS
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to build and use various types of edge forms. The student will show this knowledge by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with edge forms to their correct definitions.
2. Name types of pours using edge forms.
3. Name materials used for edge forms.
4. Identify parts of edge forms.
5. Match terms associated with joints to their correct definitions.
6. Name reasons for using joints in pavements.
7. Identify types of joints used in pavements.
8. List types of sealants used in joints.
9. Identify types of curbs and curb and gutters.
10. Label types of stairs.
11. Identify parts of a stair form.
12. Name types of stair slabs.
13. Identify types of stair forms for each type of slab.
14. State rules for unit rise and run.
15. Calculate number of risers and number and width of treads for a stair of given dimensions.
16. Demonstrate the ability to
    a. Construct edge forms for a slab on grade without foundation.
    b. Construct edge forms for a slab on grade with foundation.

OBJECTIVE SHEET

c. Construct edge forms for a patio with radius.

d. Construct forms for small set of stairs.

e. Construct forms for earth-supported stairs.

f. Construct forms for suspended stairs.

EDGE FORMS
UNIT II

SUGGESTED ACTIVITIES

I. Instructional materials

   A. Objective sheet

   B. Suggested activities

   C. Transparency masters

      1. TM #1 — Types of Pours Using Edge Forms
      2. TM #2 — Types of Pours Using Edge Forms (Continued)
      3. TM #3 — Edge Form Without Wall
      4. TM #4 — Edge Form With Wall
      5. TM #5 — Types of Joints
      6. TM #6 — Types of Joints (Continued)
      7. TM #7 — Curbs and Curb and Gutter Forms
      8. TM #8 — Types of Stairs
      9. TM #9 — Types of Stair Slabs
      10. TM #10 — Unit Rise and Unit Run

   D. Information sheet

   E. Job sheets

      1. Job Sheet #1 — Construct Edge Forms for a Slab on Grade Without Foundation
      2. Job Sheet #2 — Construct Edge Forms for a Slab on Grade With Foundation
      3. Job Sheet #3 — Construct Edge Forms for a Patio with Radius
      4. Job Sheet #4 — Construct Forms for Small Set of Stairs
      5. Job Sheet #5 — Construct Forms for Earth-Supported Stairs
      6. Job Sheet #6 — Construct Forms for Suspended Stairs

SUGGESTED ACTIVITIES

F. Test

G. Answers to test

II. Suggested activities

A. Review unit and plan presentation.

B. Obtain materials needed to supplement unit.

(NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/ Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006; phone 202-393-2040.)

C. Introduce unit.

SUGGESTIONS:

- Display edge forms or use Transparencies #1 and #2 to show how common requirements for edge forms are.
- Tour a construction site to point out edge forms in use.
- Review the units "Concrete Foundations," "Special Applications," and "Footing and Foundation Forms"; relate the concepts in these units to edge forms.

D. Provide students with objective sheet.

E. Discuss unit and specific objectives.

SUGGESTIONS:

- Relate objectives to your introduction of unit.
- Relate job sheets to specific objectives.

F. Provide students with information and job sheets.

G. Discuss information and job sheets.

1. Use Information Sheet, Section I to discuss terms associated with edge forms, using actual samples of materials and edge forms to illustrate terms.
2. Use Information sheet, Section II and Transparencies #1 and #2 to discuss types of pours using edge forms.

SUGGESTED ACTIVITIES

SUGGESTIONS:

- Show students examples of pours and the forms used with them.
- Emphasize the importance of straight, level forms with adequate bracing, especially if puddling and vibrating are used; point out that stair forms may even need to support the weight of cement masons who must finish the concrete.

3. Use Information Sheet, Section III to discuss materials used for edge forms, showing students samples of each and relating them to types of pours.

4. Use Information Sheet, Section IV and Transparencies #3 and #4 to discuss parts of edge forms.

   SUGGESTIONS:

   - Use actual edge forms or models of edge forms to illustrate parts.
   - Explain the function of each part.
   - Point out differences between forms with and without walls.
   - Demonstrate Job Sheets #1, #2, and #3 and allow students to practice procedures; do mock-ups at training facility if construction project does not require these types of skills.

5. Use Information Sheet, Section V to discuss terms associated with joints.

   SUGGESTIONS:

   - Relate terms to edge forms.
   - Clarify differences of types of joints, such as construction, contraction, expansion, and other joints.

6. Use Information Sheet, Section VI to discuss purposes of joints.

   SUGGESTIONS:

   - Take students to various sites to view defective pours, such as highway concrete that has popped up and spalled on each side of expansion joints, cracks in curbs and slabs, etc.
   - Point out the various types of joints and relate them to the purposes of joints.
   - Discuss how joints are established.

7. Use Information Sheet, Section VII and Transparencies #5 and #6 to discuss types of joints, relating each type to the purposes of forms and the terms covered in Section V.

SUGGESTED ACTIVITIES

8. Use Information Sheet, Section VIII to discuss types of sealants.

   SUGGESTIONS:

   - Emphasize the differences between elastomers and mastics, pointing out the suitability of each type for various applications.
   - Show the class samples of the different types of sealants.
   - Point out sealants in use at various construction sites.

9. Use Information Sheet, Section IX and Transparency #7 to discuss types of curbs and curb and gutter forms.

   SUGGESTIONS:

   - Point out curbs and curb and gutters of the various types.
   - Display forms used for the various types of curb pours.
   - Emphasize the use of bracing curb forms and using sealants in the joints on curbs.

10. Use Information Sheet, Section X and Transparency #8 to discuss stair designs, visiting sites with each type of stair if possible.

11. Use Information Sheet, Section XI to discuss stair forms.

    SUGGESTIONS:

    - Use models to show how stair forms fit together.
    - Introduce next section by relating parts of forms to types of slabs and the importance of the various parts.

12. Use Information Sheet, Section XII and Transparency #9 to discuss types of stair slabs.

    SUGGESTIONS:

    - Show students examples of each type of slab.
    - Discuss uses and reasons for each type of slab.

13. Use Information Sheet, Section XIII to discuss details of types of stair forms.

    SUGGESTIONS:

    - Demonstrate the use of a framing square and stair gauge in marking stair forms.
    - Demonstrate Job Sheets #4 through #6, emphasizing safety and sound building practices.
    - Review Supplement from Unit I, "Footing and Foundation Forms."

SUGGESTED ACTIVITIES

14. Use Information Sheet, Sections XIV and XV and Transparency #10 to discuss how to calculate the number of risers and treads for stairs of given dimensions.

SUGGESTIONS:

- Make sure that students understand that plans of stairs on blueprints seldom show actual dimensions of stairs that can be used for actual construction.

- Use floor plans or create problems to allow students practice in computing riser and tread dimensions.

- Allow students to construct forms using Job Sheet #4 through #6.

H. Review unit.

I. Give test.

J. Reteach and retest if necessary.

K. Complete appropriate section of competency profiles.

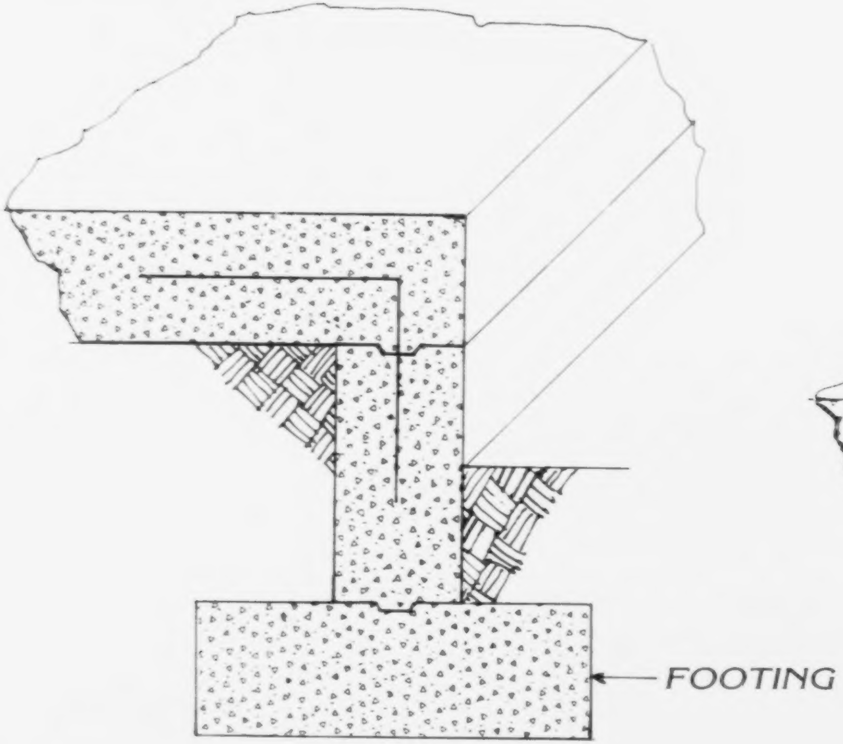
III. Unit references

A. Hendrix, Laborn J. "Bud." *Cement Masonry.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1975.

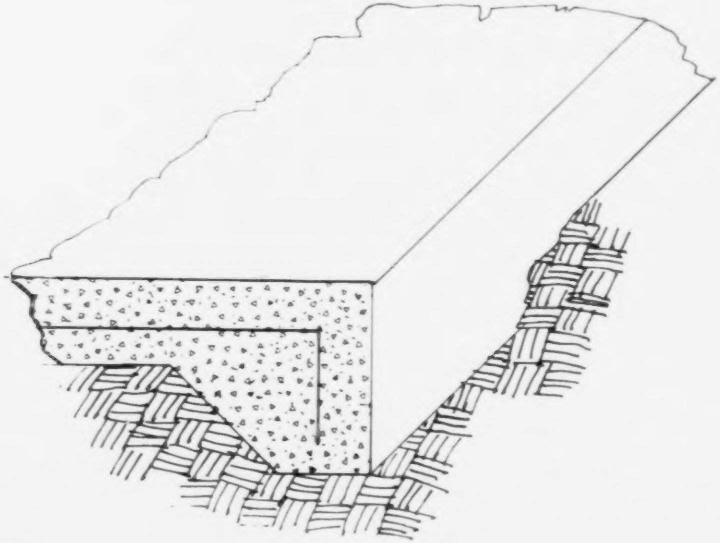
B. Hendrix, Laborn J. "Bud." *Commercial Carpentry.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1979.

C. Penner, Wayman R. *Residential Carpentry.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1973.

Types of Pours Using Edge Forms



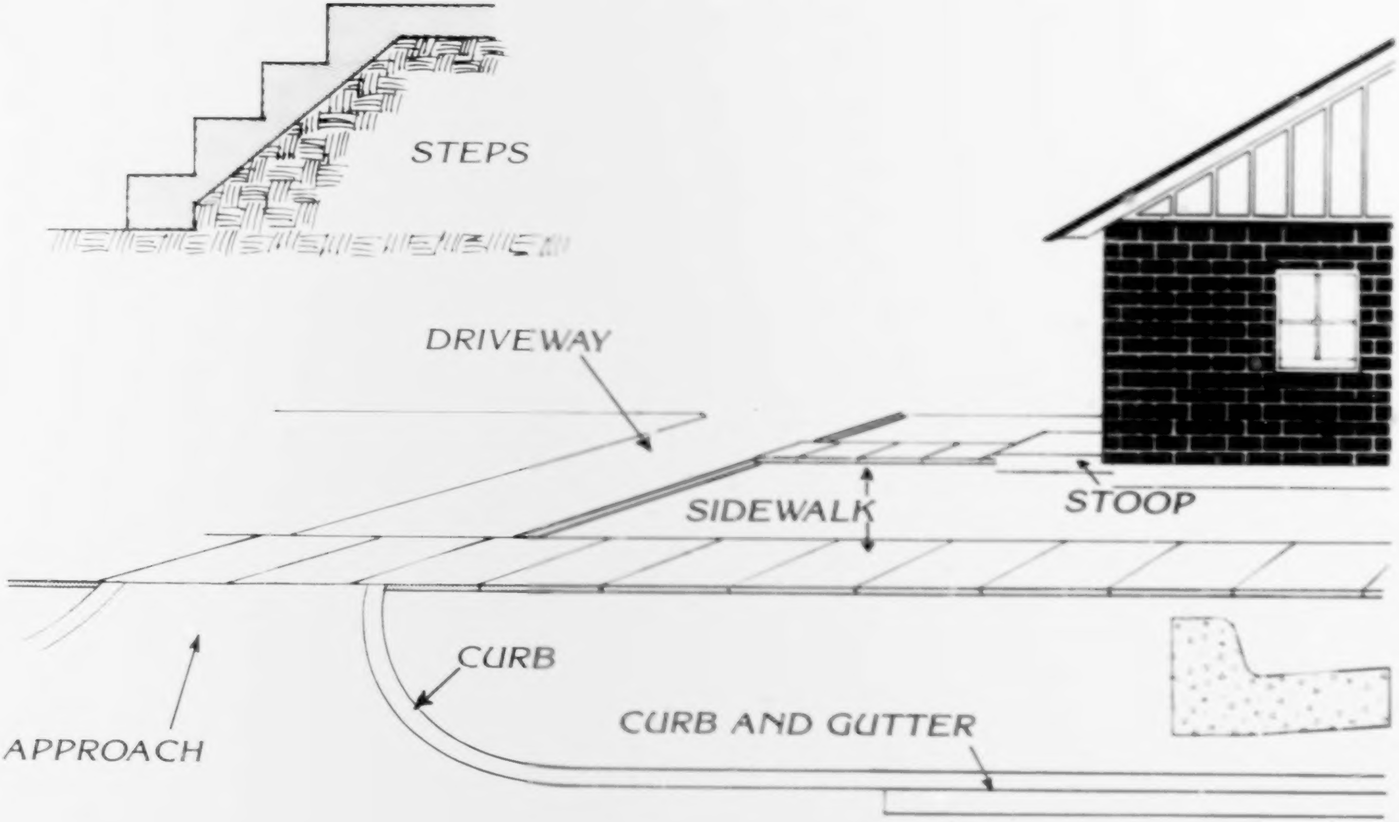
FLOOR WITH FOUNDATION



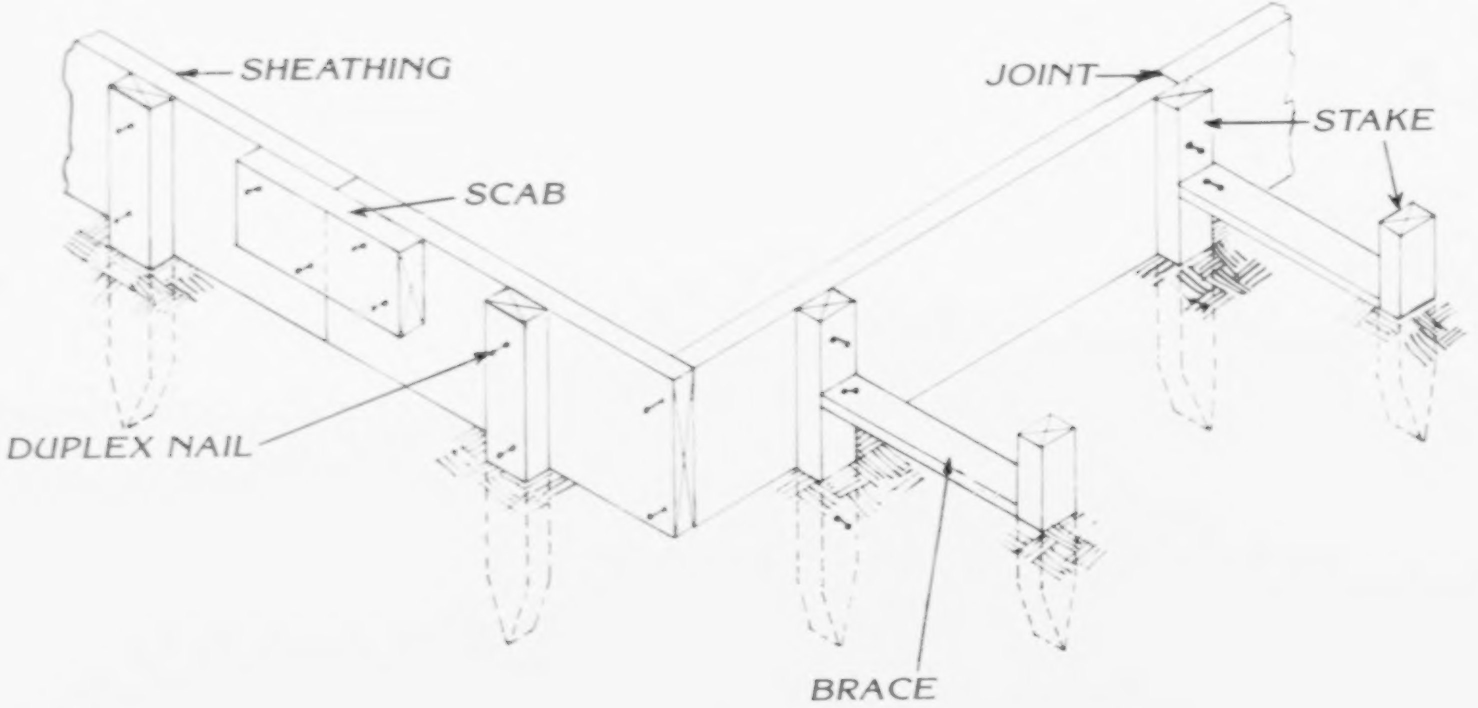
FLOOR WITHOUT FOUNDATION

Types of Pours Using Edge Forms

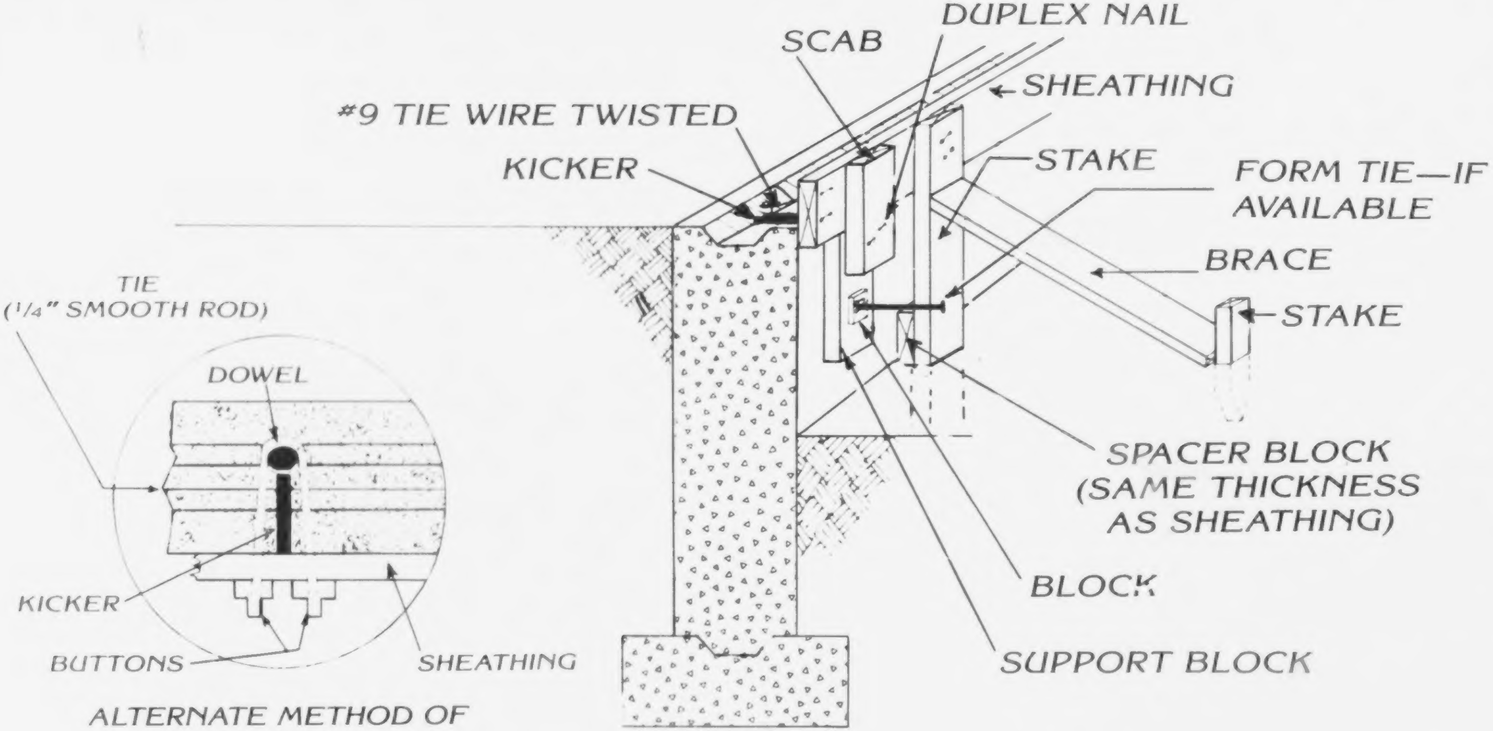
(Continued)


STEPS
DRIVEWAY
SIDEWALK
STOOP
CURB
APPROACH
CURB AND GUTTER

Edge Form Without Wall

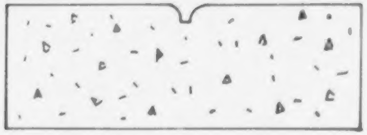

SHEATHING
JOINT
STAKE
SCAB
DUPLEX NAIL
BRACE

Edge Form with Wall

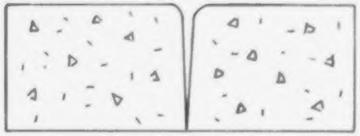

DUPLEX NAIL
SCAB
SHEATHING
#9 TIE WIRE TWISTED
STAKE
KICKER
FORM TIE—IF AVAILABLE
BRACE
STAKE
SPACER BLOCK (SAME THICKNESS AS SHEATHING)
BLOCK
SUPPORT BLOCK
TIE (1/4" SMOOTH ROD)
DOWEL
KICKER
BUTTONS
SHEATHING

ALTERNATE METHOD OF TYING FORM TO WALL

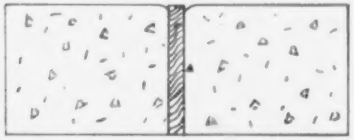
Types of Joints



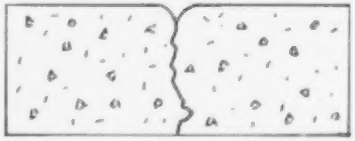
TOOLED DUMMY JOINT



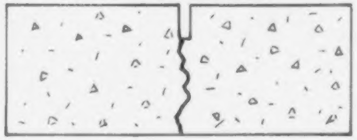
OPEN JOINT FOR FILLING



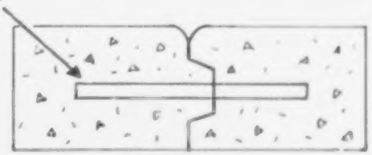
DECORATIVE JOINT
WITH WOOD SPACER



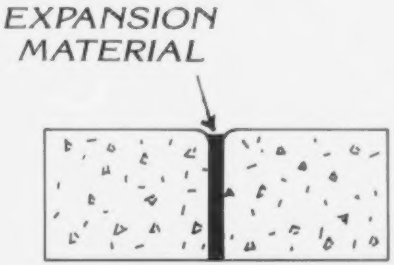
TOOLED CONTROL JOINT



SAWED CONTROL JOINT


DEFORMED TIE BARS

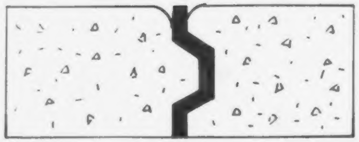
TOOLED CONSTRUCTION
JOINT WITH KEYWAY


EXPANSION
MATERIAL

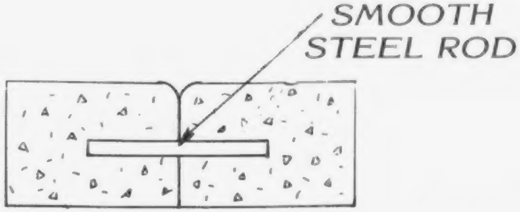
TOOLED CONSTRUCTION JOINT
WITH EXPANSION MATERIAL

Types of Joints

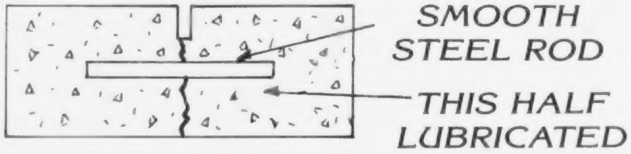
(Continued)



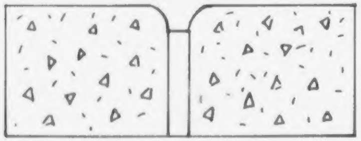
TOOLED CONSTRUCTION JOINT
WITH KEYED EXPANSION


SMOOTH
STEEL ROD

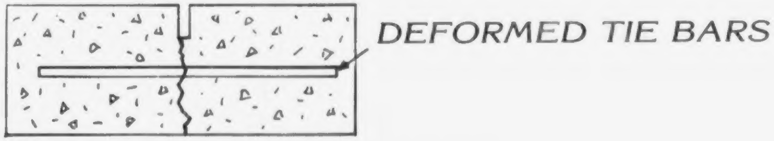
TOOLED CONSTRUCTION JOINT
WITH STEEL DOWEL


SMOOTH
STEEL ROD
THIS HALF
LUBRICATED

SAWED CONTRACTION JOINT
WITH STEEL DOWEL

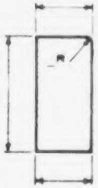


TOOLED ISOLATION JOINT
HELD DOWN FOR SEALANT

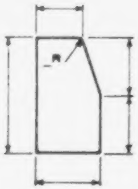

DEFORMED TIE BARS

SAWED LONGITUDINAL JOINT

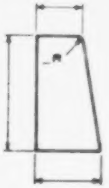
Curbs and Curb and Gutter Forms



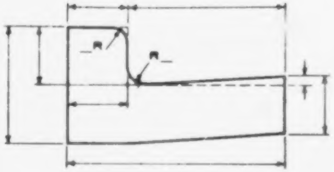
STRAIGHT CURB



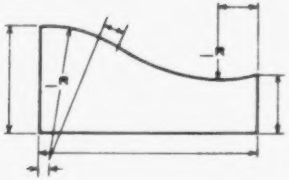
PARTIALLY
BATTERED CURB



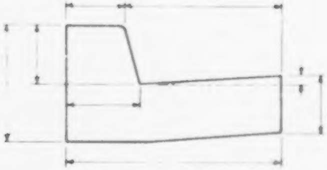
FULLY
BATTERED CURB



DOUBLE RADIUS
VERTICAL

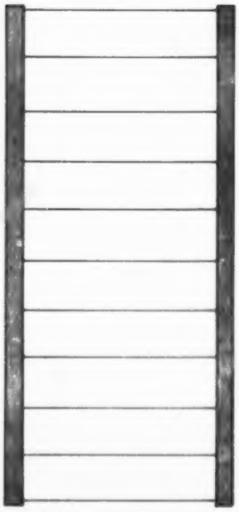


ROLL TYPE

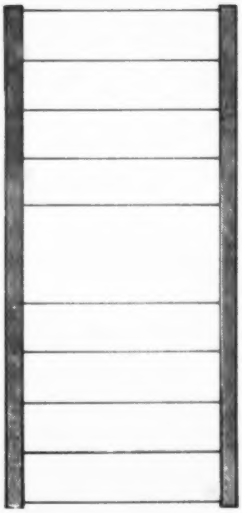


STRAIGHT FACE
BATTERED

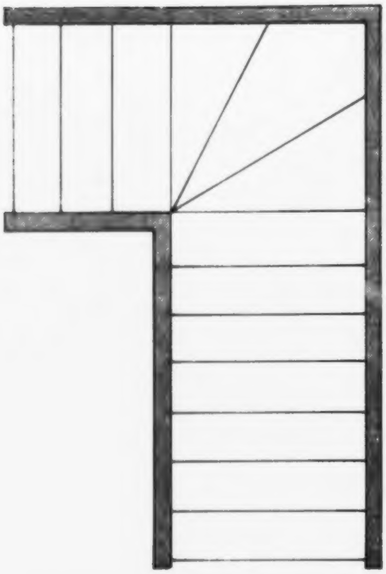
Types of Stairs



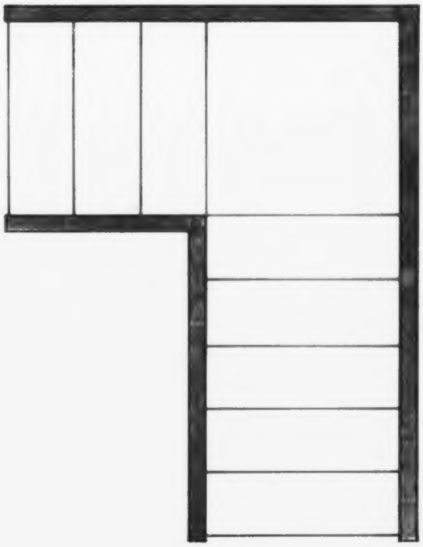
STRAIGHT FLIGHT



STRAIGHT FLIGHTS WITH LANDING

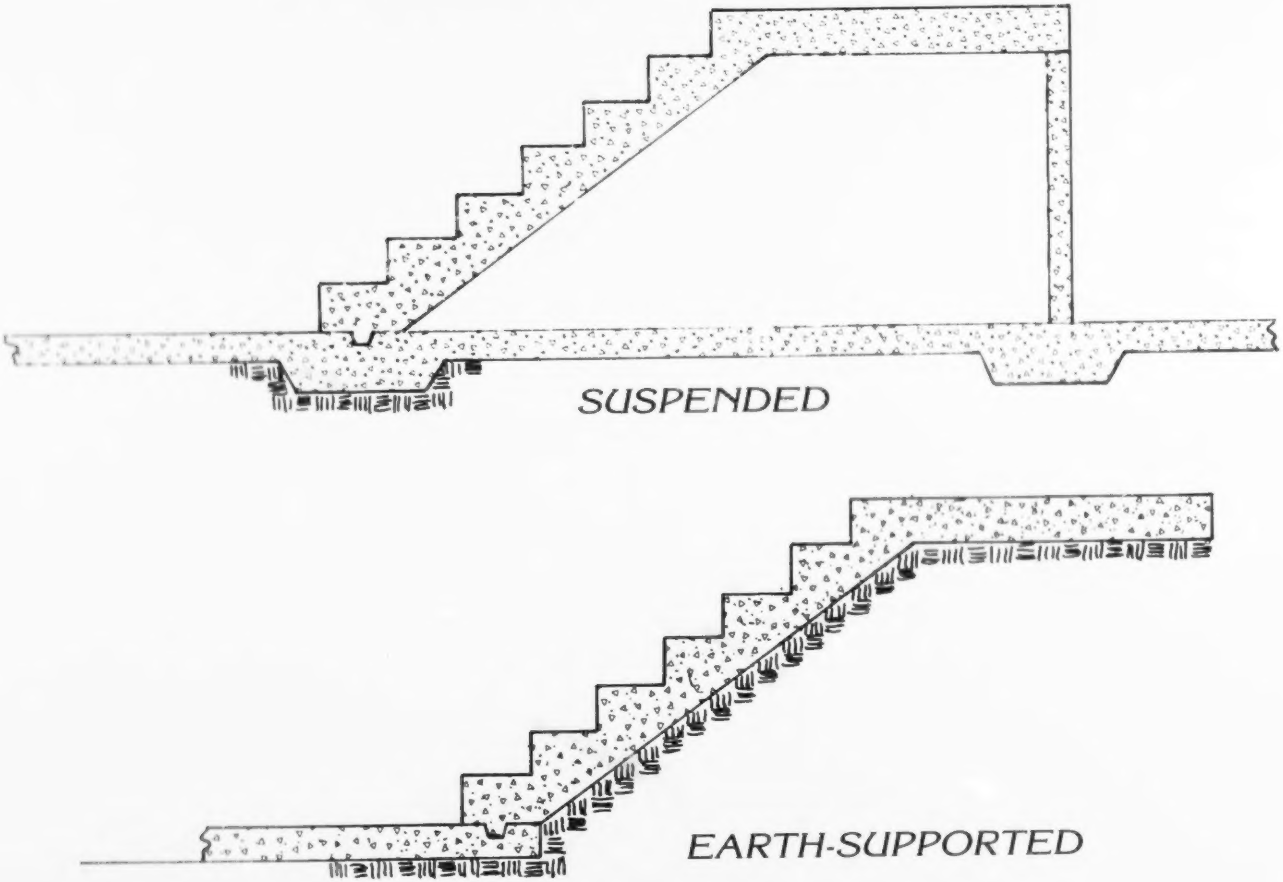


90-DEGREE FLIGHTS WITH WINDERS



90-DEGREE FLIGHTS WITH LANDING

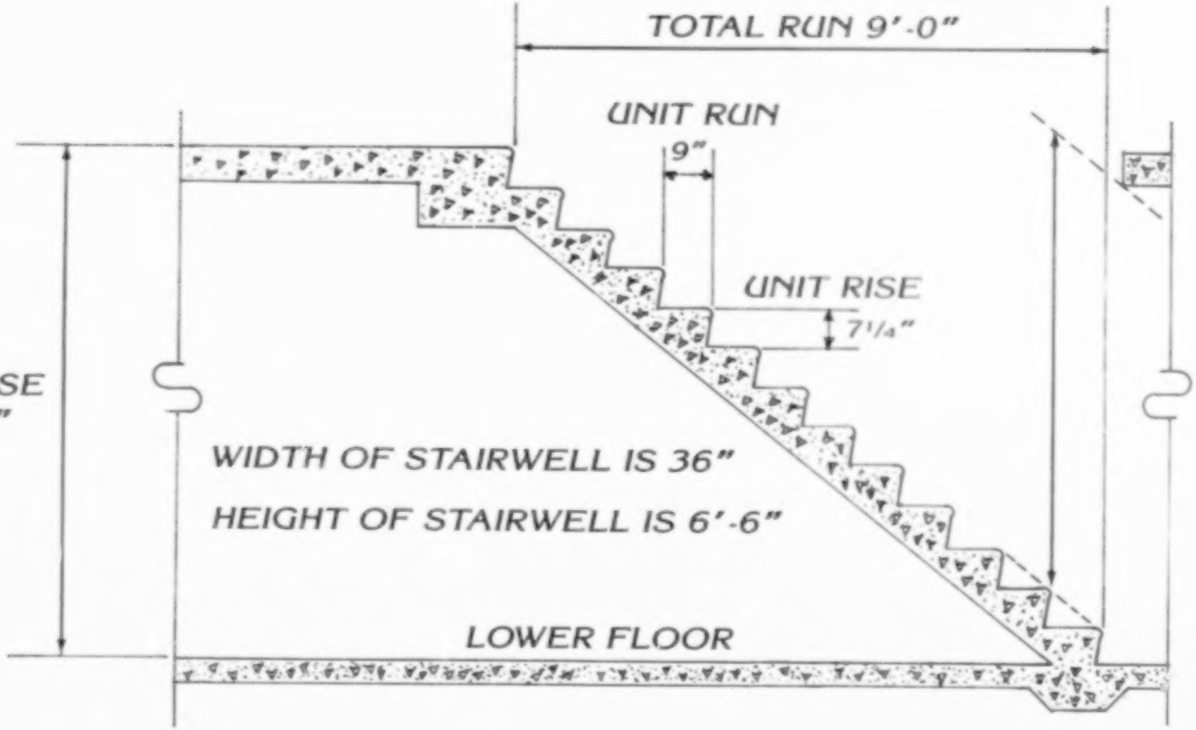
Types of Stair Slabs


SUSPENDED
EARTH-SUPPORTED

211

212

Unit Rise and Unit Run


TOTAL RUN 9'-0"
UNIT RUN
9"
UNIT RISE
7¼"
TOTAL RISE
7'-10¼"
WIDTH OF STAIRWELL IS 36"
HEIGHT OF STAIRWELL IS 6'-6"
LOWER FLOOR

UNIT RUN = 9" to 11"

UNIT RISE = 7" to 8"

EDGE FORMS
UNIT II

INFORMATION SHEET

I. Terms and definitions

  A. Edge form — Low form placed at the perimeter of a slab

  B. Battered — Receding upward slope of the face of a form or curb

  C. Hardboard — Type of fiberboard made from wood fibers

  D. Scab — Piece of material nailed across a splice to hold both pieces together to help strengthen the joint

  E. Subgrade — Soil prepared and compacted to support a structure or pavement system

  F. Pitch board — Wood block used as a pattern to lay out steps and to support treads and risers

  G. Riser — Vertical part of a stair step

  H. Tread — Horizontal part of a stair step

  I. Unit rise — Distance from floor to top of a landing or to next floor

  J. Unit run — Horizontal distance between first riser and face of platform or stair opening above

  K. Stair gauge — Device attached to a framing square to ensure accuracy when laying out material, such as stairs and rafters

II. Types of pours using edge forms

  A. Footings

  B. Floor with foundation

  C. Floor without foundation

  D. Stoop, porch, or patio

  E. Sidewalk

  F. Driveway and approach

  G. Curb or curb and gutter

  H. Steps

III. Materials used for edge forms

  (NOTE: Materials may be used individually or in combination with each other.)

  A. Wood

  B. Metal

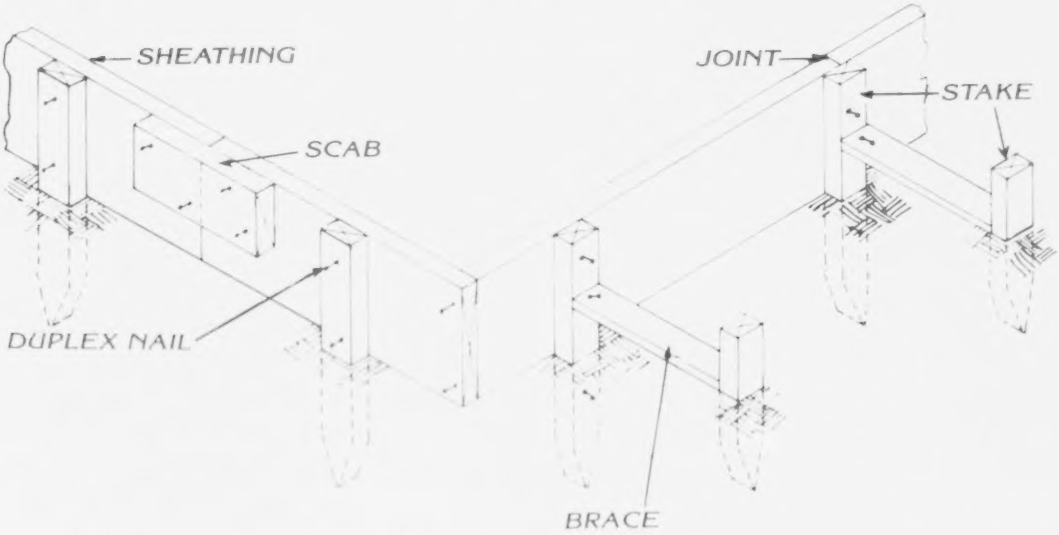
  C. Hardboard

INFORMATION SHEET

IV. Parts of edge forms

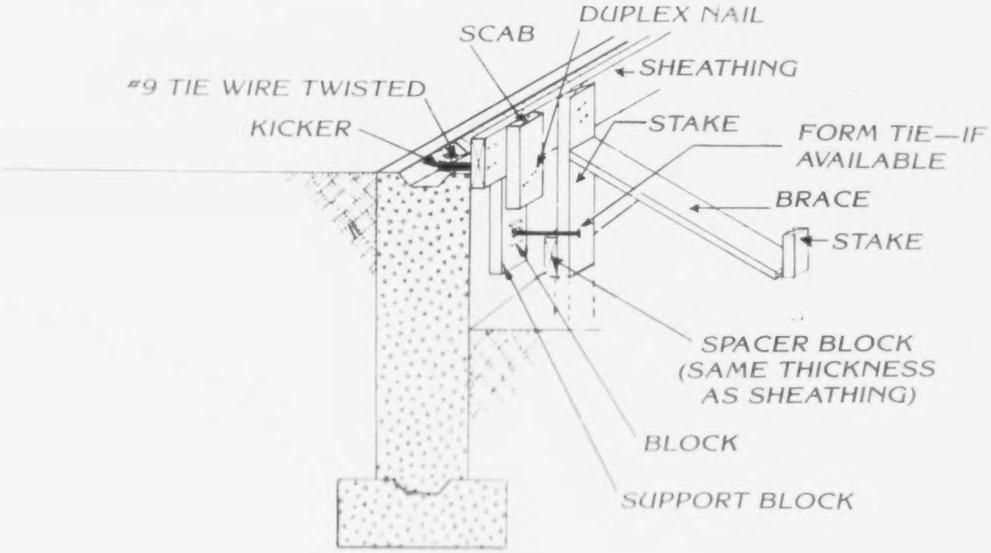
A. Form without wall (Figure 1)

FIGURE 1


SHEATHING
JOINT
STAKE
SCAB
DUPLEX NAIL
BRACE

B. Form with wall (Figures 2 and 3)

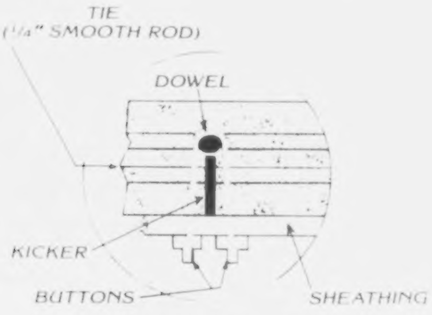
FIGURE 2


SCAB
DUPLEX NAIL
SHEATHING
#9 TIE WIRE TWISTED
KICKER
STAKE
FORM TIE—IF AVAILABLE
BRACE
STAKE
SPACER BLOCK (SAME THICKNESS AS SHEATHING)
BLOCK
SUPPORT BLOCK

INFORMATION SHEET

EXAMPLE: Alternate method of tying form to wall

FIGURE 3



ALTERNATE METHOD OF TYING FORM TO WALL

V. Terms and definitions associated with joints

A. Joint — Separation or cut made in concrete for a specific purpose

B. Control joint — Joint cut into concrete to control and induce cracking at a particular point rather than at random; also used to control transverse and longitudinal cracking and slab movement, and to divide concrete into suitable spacings

C. Contraction joint — Type of control joint

D. Isolation joint — Joint placed to isolate one section of concrete from another and to isolate concrete from other rigid objects

E. Expansion joint — Type of isolation joint

F. Longitudinal joint — Joint placed lengthwise in slab or pavement

G. Construction joint — Planned or emergency joint placed where pour is temporarily suspended

H. Dummy joint — Joint placed in sidewalks, patios, and other slabs strictly for design

I. Skewed joint — Control joint placed obliquely across a slab or pavement

J. Jointer — Tool used to cut grooves in concrete

K. Expansion material — Preformed, compressible material used to separate units of concrete to prevent damage due to expansion

INFORMATION SHEET

- L. Sealant — Any of various sealing agents
- M. Caulk — Waterproof material used as a sealant
- N. Caulking gun — Tool used to apply caulk
- O. Transverse — Pertaining to a crack occurring crosswise in slab or pavement

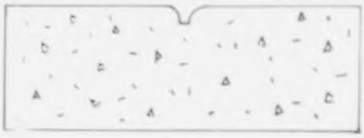
VI. Reasons for using joints in pavements

- A. To control transverse and longitudinal cracking
- B. To control slab movement
- C. To divide pavement into suitable spacings

VII. Types of joints used in pavements (Figures 4-11)

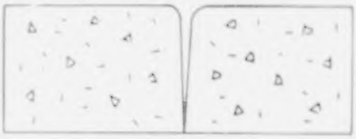
A. Tooled dummy joint

FIGURE 4



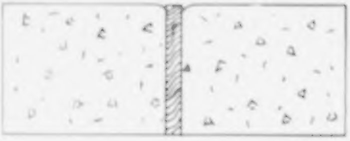
B. Open joint for filling

FIGURE 5



C. Decorative joint with wood spacer

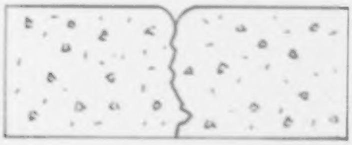
FIGURE 6



INFORMATION SHEET

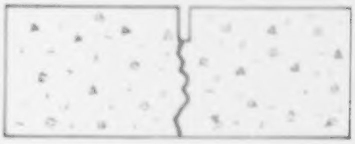
D. Tooled control joint

FIGURE 7



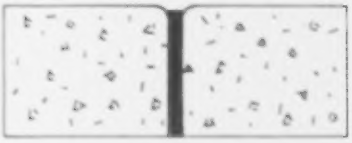
E. Sawed control joint

FIGURE 8



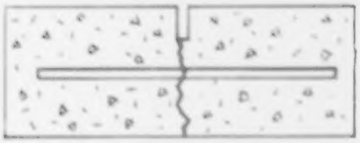
F. Tooled construction joint with expansion material

FIGURE 9



G. Sawed contraction joint with steel dowel

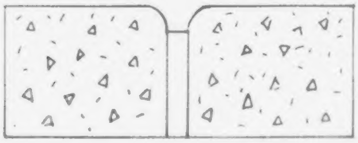
FIGURE 10



INFORMATION SHEET

H. Tooled isolation joint held down for sealant

FIGURE 11



VIII. Types of sealants used in joints

A. Elastomers (polymers)

(NOTE: Elastomers are rubberlike substances that are generally flexible and water-resistant. Often they harden completely or on the surface when exposed to air.)

EXAMPLES: Silicone, polyurethane

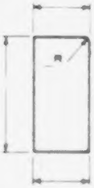
B. Mastics

(NOTE: Mastics are made of tar, asphalt, or similar substances mixed with oils or sand. Mastics resemble putty or paste.)

IX. Types of curbs and curb and gutters (Figures 12-17)

A. Straight curb

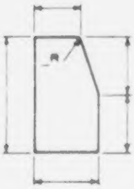
FIGURE 12



INFORMATION SHEET

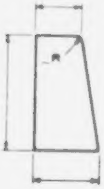
B. Partially battered curb

FIGURE 13



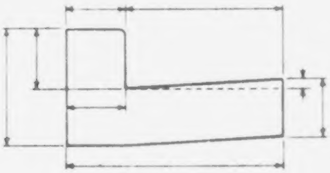
C. Fully battered curb

FIGURE 14



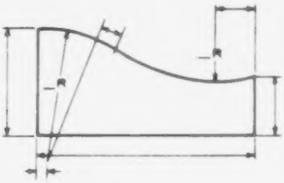
D. Single-radius curb and gutter, vertical

FIGURE 15



E. Roll-type curb and gutter

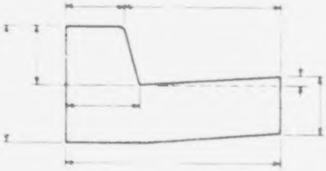
FIGURE 16



INFORMATION SHEET

F. Straight-face curb and gutter, battered

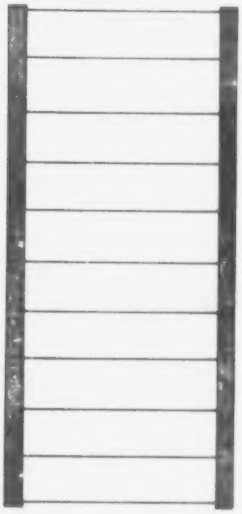
FIGURE 17



X. Types of stairs (Figures 18-21)

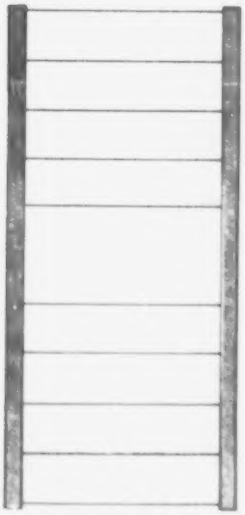
A. Straight flight

FIGURE 18



B. Straight flights with landing

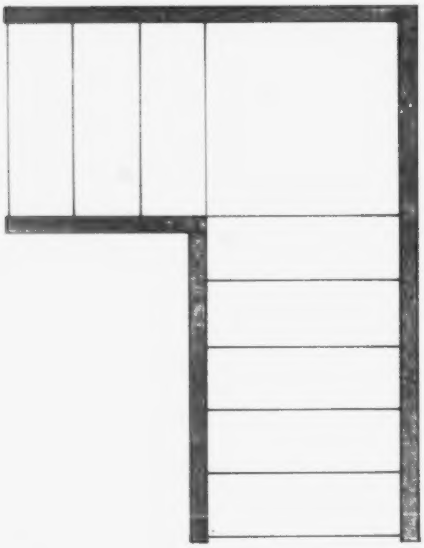
FIGURE 19



INFORMATION SHEET

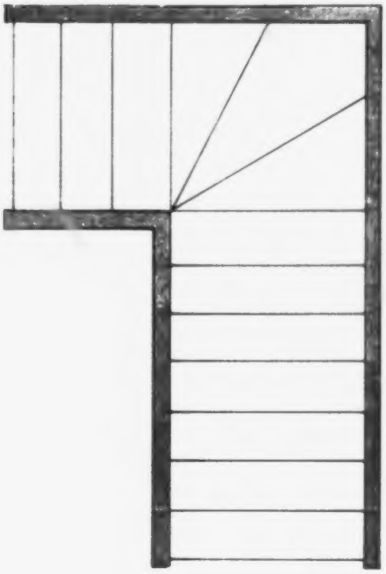
C. Ninety-degree flights with landing

FIGURE 20



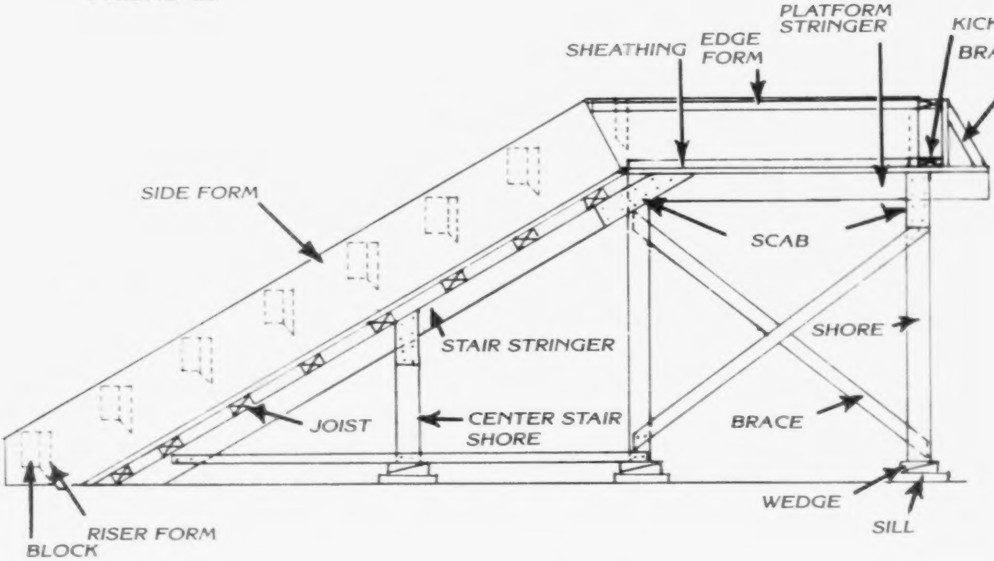
D. Ninety-degree flights with winders

FIGURE 21



XI. Parts of a stair form (Figure 22)

FIGURE 22


SHEATHING
EDGE FORM
PLATFORM STRINGER
KICKER
BRACE
SIDE FORM
SCAB
STAIR STRINGER
SHORE
JOIST
CENTER STAIR SHORE
BRACE
WEDGE
SILL
RISER FORM
BLOCK

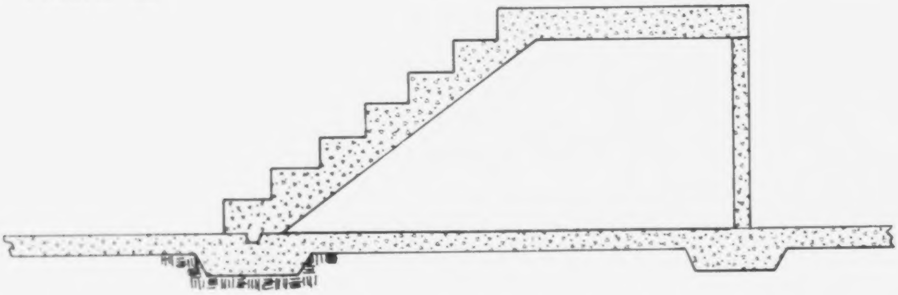
INFORMATION SHEET

XII. Types of stair slabs (Figures 23 and 24)

A. Suspended

EXAMPLE:

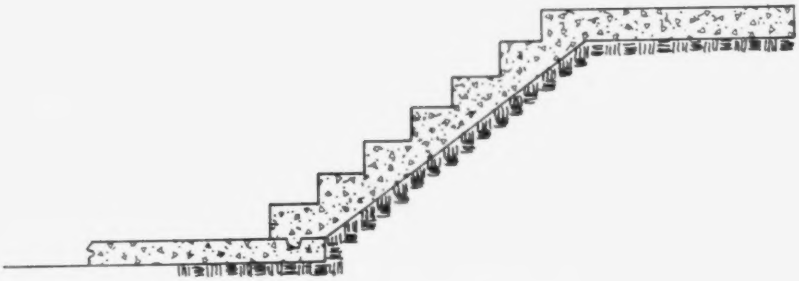
FIGURE 23



B. Earth-supported

EXAMPLE:

FIGURE 24

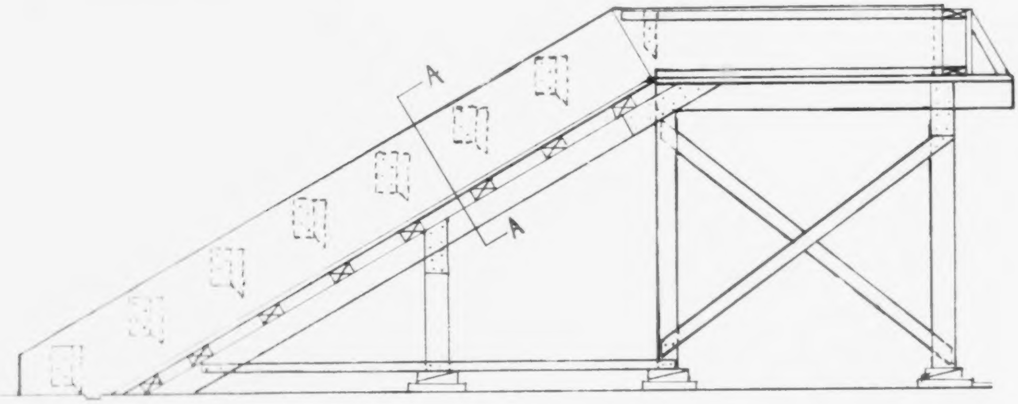


INFORMATION SHEET

XIII. Types of stair forms for each type of slab

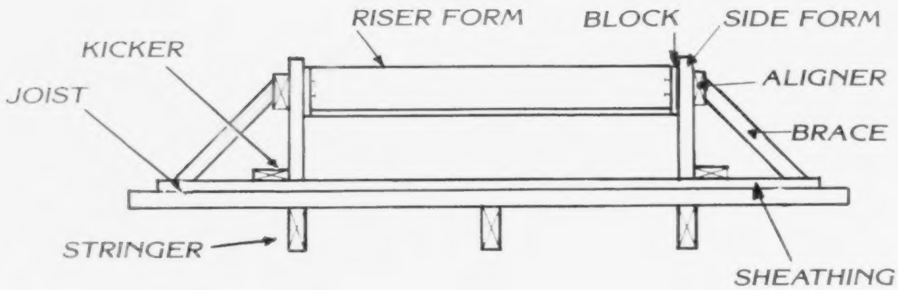
A. Suspended, forms open on sides (Figures 25 and 26)

FIGURE 25



EXAMPLE: Section view

FIGURE 26

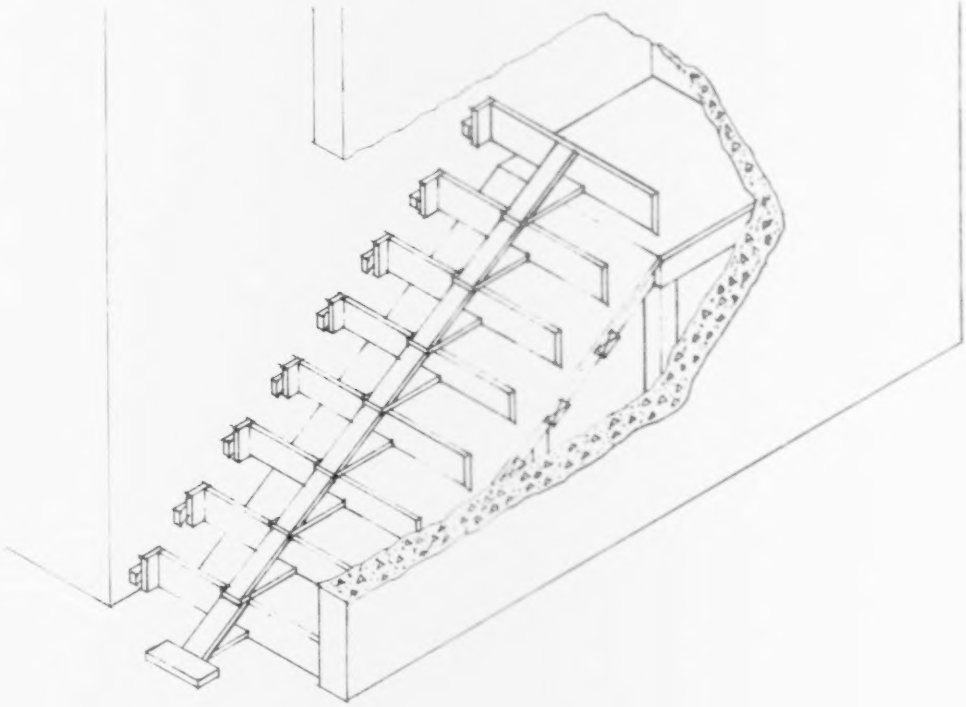

RISER FORM
BLOCK
SIDE FORM
KICKER
ALIGNER
JOIST
BRACE
STRINGER
SHEATHING

INFORMATION SHEET

B. Suspended between walls (Figures 27 and 28)

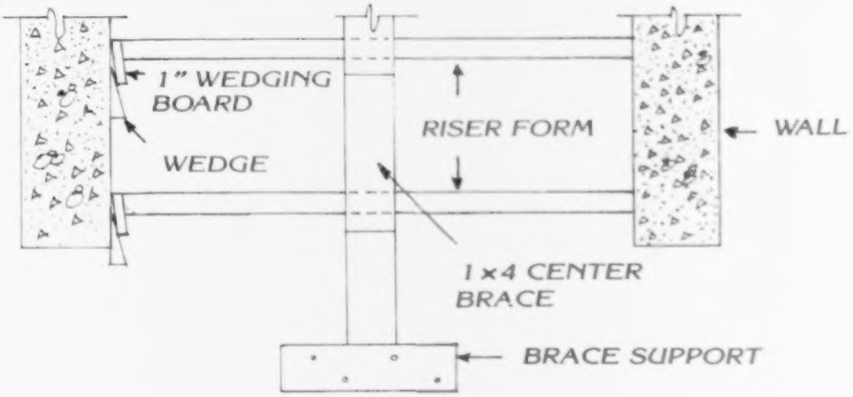
(NOTE: If stairs are 4 feet wide or wider, it is necessary to add a center stringer or center braces as shown in Figure 27.)

FIGURE 27



EXAMPLE: Plan view

FIGURE 28

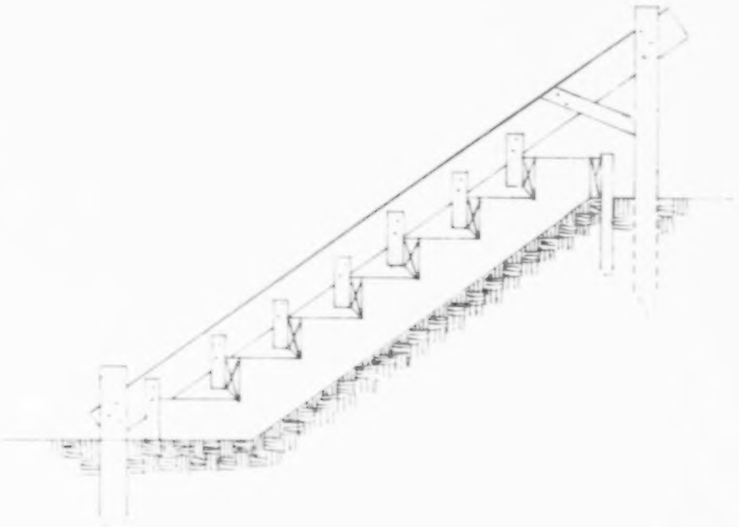

1" WEDGING BOARD
WEDGE
RISER FORM
WALL
1×4 CENTER BRACE
BRACE SUPPORT

INFORMATION SHEET

C. Earth-supported between walls (Figures 29 and 30)

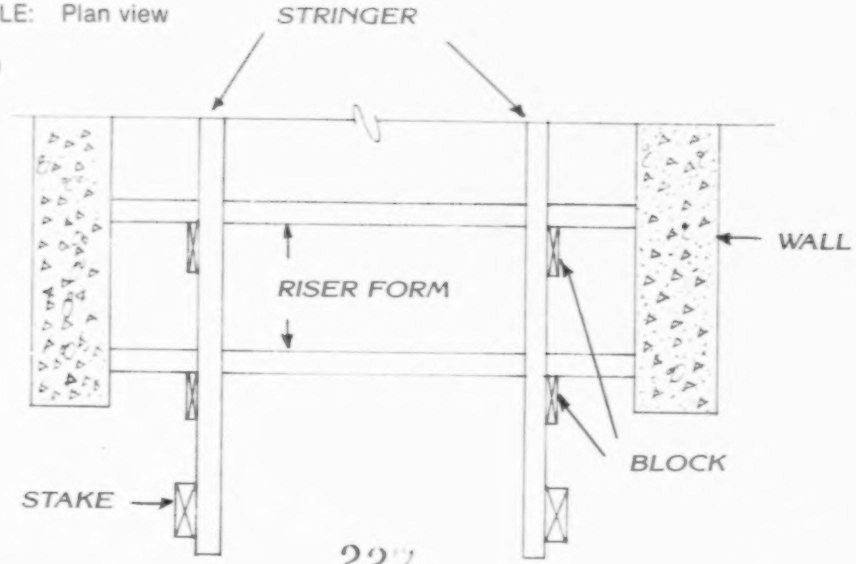
(NOTE: If stairs are 4 feet wide or wider, it is necessary to add a center stringer or center braces.)

FIGURE 29



EXAMPLE: Plan view

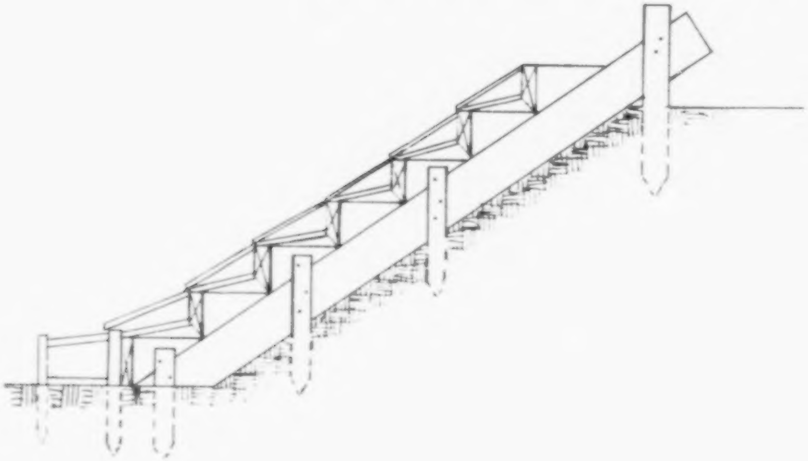
FIGURE 30


STRINGER
WALL
RISER FORM
BLOCK
STAKE

INFORMATION SHEET

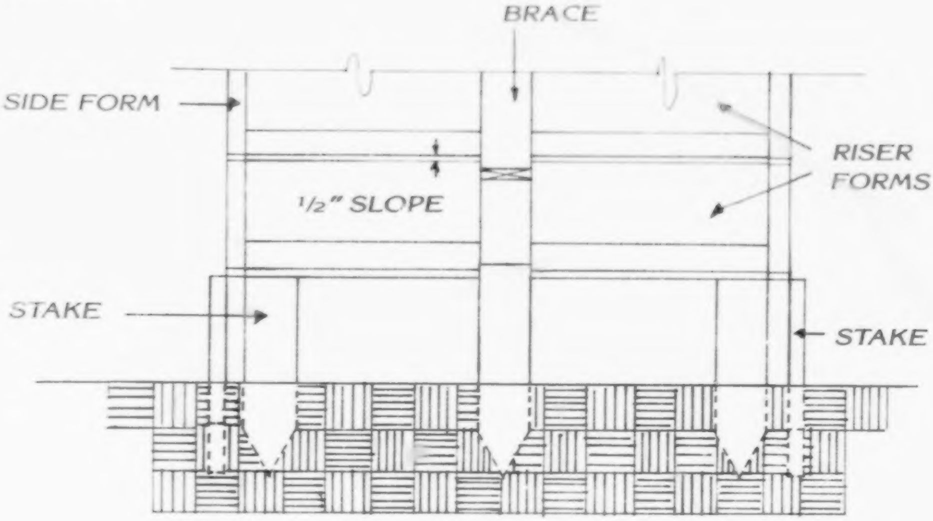
D. Earth-supported, open on sides (Figures 31 and 32)

FIGURE 31



EXAMPLE: Elevation view

FIGURE 32


BRACE
SIDE FORM
RISER FORMS
1/2″ SLOPE
STAKE
STAKE

INFORMATION SHEET

XIV. Rules for unit rise and unit run

A. Total of one riser and one tread should be not less than 16 inches or more than 18 inches

B. Unit rise should be 7 inches to 8 inches

C. Unit run should be 9 inches to 11 inches

(NOTE: As the rise increases, the run must decrease proportionally.)

D. Treads and risers *must* be the same size as other treads and risers for any given set of stairs

XV. Calculating risers and treads for a stair

A. Risers

1. Determine total rise of the stair in inches

   (NOTE: Total rise of a stair is from the finished floor of the lower level to the top of the finished floor of the upper level.)

2. Divide total rise of the stair by 7 to find the number of risers needed

   (NOTE: Seven inches is the minimum height of a riser.)

3. Round back to the nearest whole number

   EXAMPLE: Total rise is $7'\text{–}10\frac{1}{4}''$; or $94\frac{1}{4}$ inches.

   $94\frac{1}{4}$ inches $\div 7 = 13.46$ inches or $13\frac{7}{16}$ inches each.

   7/16 will not make a full riser, so round back to 13 full risers.

4. Divide total rise by number of risers

   EXAMPLE: $94\frac{1}{4}$ inches $\div 13 = 7\frac{1}{4}$ inches each

   There would be 13 risers of $7\frac{1}{4}$ inches each.

B. Treads

1. Determine total run of the stair in inches

   (NOTE: Total run of the stair is the horizontal distance from a point at the head of the stair to the outside edge of the last riser.)

INFORMATION SHEET

2. Determine number of treads by subtracting 1 from the number of risers

   (NOTE: There is always one less tread than there are risers.)

3. Divide total run by number of treads

   EXAMPLE: Total run is 9′–9″ or 117 inches.

   117 inches ÷ 12 = 9.75 inches or 9¾ inches unit run

   There will be 12 treads of 9¾ inches each.

EDGE FORMS
UNIT II

JOB SHEET #1 — CONSTRUCT EDGE FORMS FOR A SLAB ON GRADE WITHOUT FOUNDATION

I. Tools and materials

  A. Tools

    1. Sledgehammer
    2. Claw hammer
    3. Power handsaw and extension cord
    4. Handsaw
    5. One-hundred-foot tape
    6. Folding rule or steel tape
    7. Hand level
    8. String line
    9. Builder's level and rod
    10. Plumb bob

  B. Materials

    1. Stakes
    2. 2×8s for sheathing
    3. 8d and 16d duplex nails
    4. 1×4s or 2×4s for braces

II. Procedure

  A. Perform site layout

  (NOTE: Review *Fundamentals of Carpentry*, "Site Layout" if necessary.)

  B. Offset line marks on batterboards the thickness of the forms ($1\frac{1}{2}$ inches)

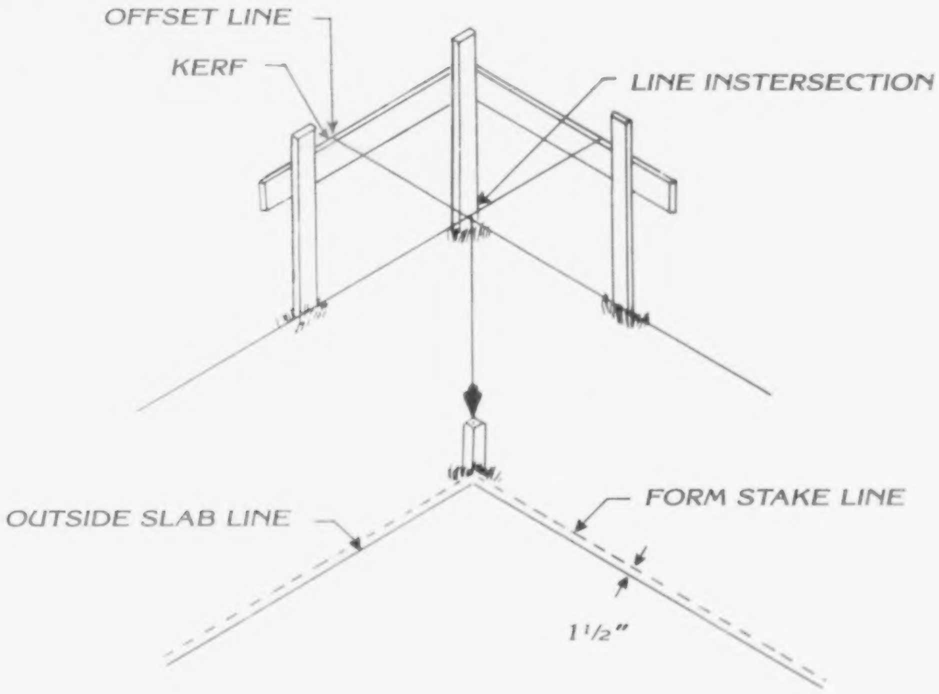
  C. Secure string lines to batterboards at new marks

  D. Attach plumb bob to line intersections

JOB SHEET #1

E. Drive corner form stake and set a nail exactly at the point of the plumb bob (Figure 33)

FIGURE 33


OFFSET LINE
KERF
LINE INSTERSECTION
OUTSIDE SLAB LINE
FORM STAKE LINE
$1\frac{1}{2}$"

F. Repeat steps D and E on the other three corners

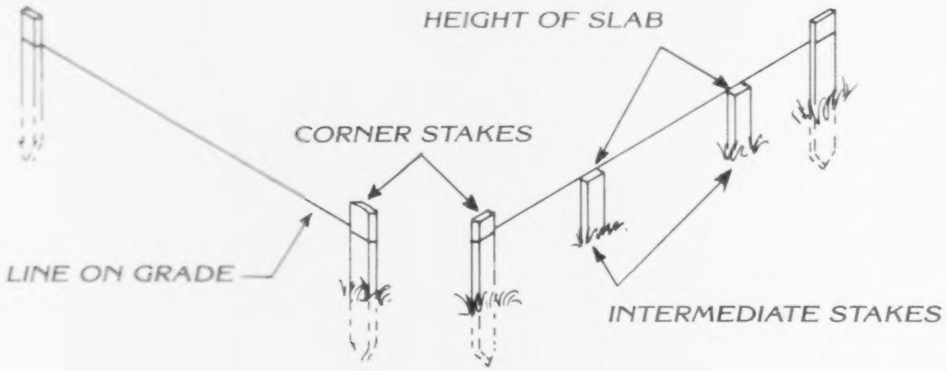
G. Establish grade on all corner stakes

H. Secure line to one corner stake on the established grade and stretch line tight to established grade on next corner stake (See Figure 34)

(NOTE: Be sure that the line is tight with no sag.)

JOB SHEET #1

FIGURE 34

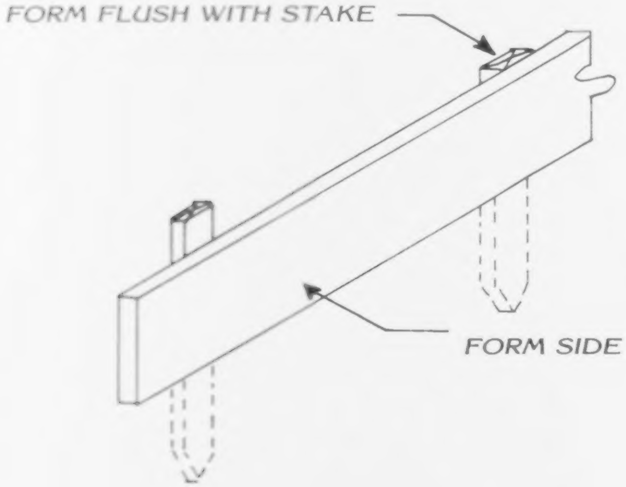

HEIGHT OF SLAB
CORNER STAKES
LINE ON GRADE
INTERMEDIATE STAKES

I. Drive all intermediate stakes (See Figures 34.)

(NOTE: Drive stakes straight down with face of stake plumb with line and top of stake flush with line.)

J. Nail 2 x 10 sheathing to stakes with top of 2 x 10 flush with grade on stakes (Figure 35)

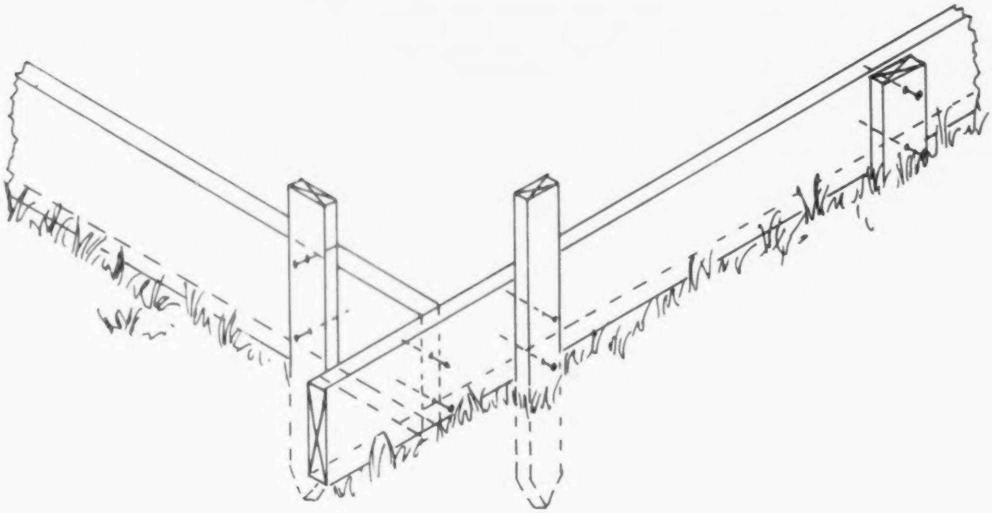
FIGURE 35


FORM FLUSH WITH STAKE
FORM SIDE

JOB SHEET #1

K. Tie all corners together as shown in Figure 36

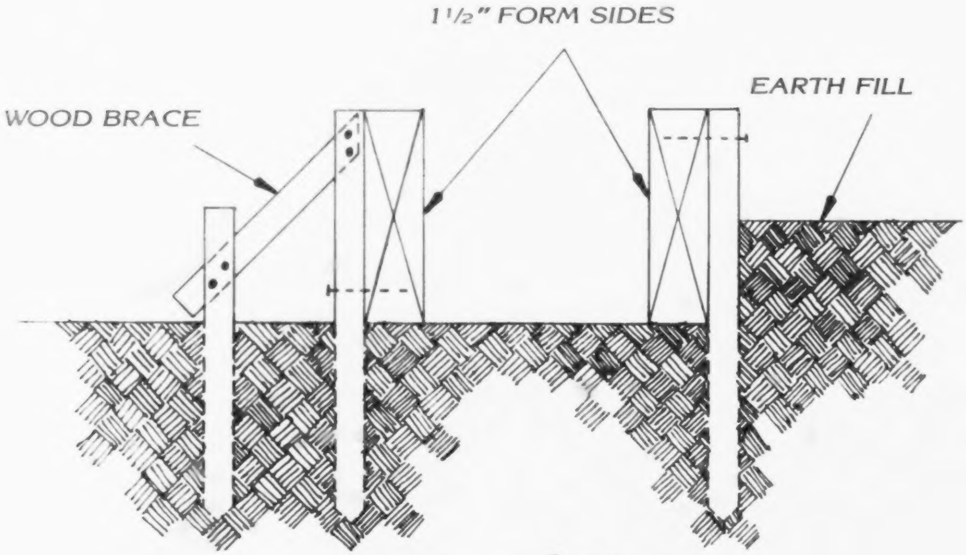
FIGURE 36



L. Brace the forms by one of the methods shown in Figure 37

(NOTE: Long stakes may be cut off flush with the top of the form.)

FIGURE 37


1½" FORM SIDES
EARTH FILL
WOOD BRACE

JOB SHEET #1

M. Make subgrade board as shown in Figures 38 and 39

(NOTE: On wide buildings, it will be necessary to set a temporary screed. See Figure 39.)

FIGURE 38

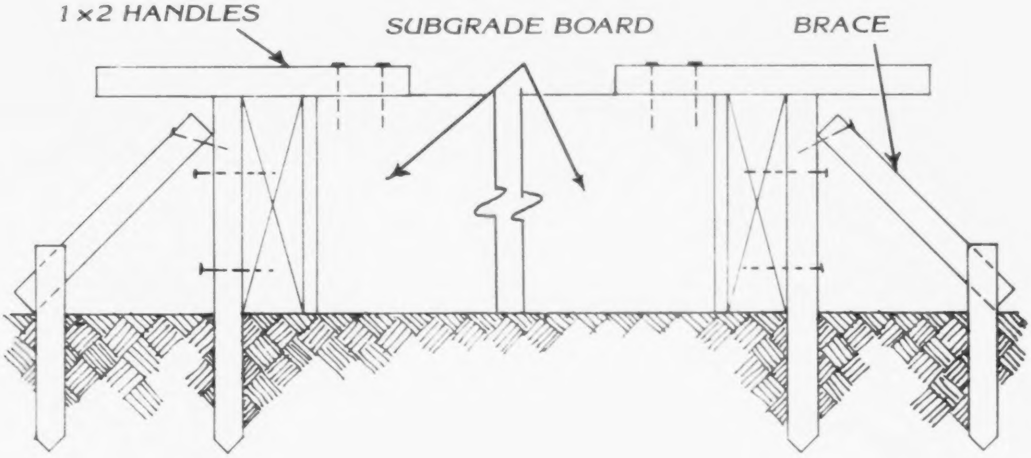
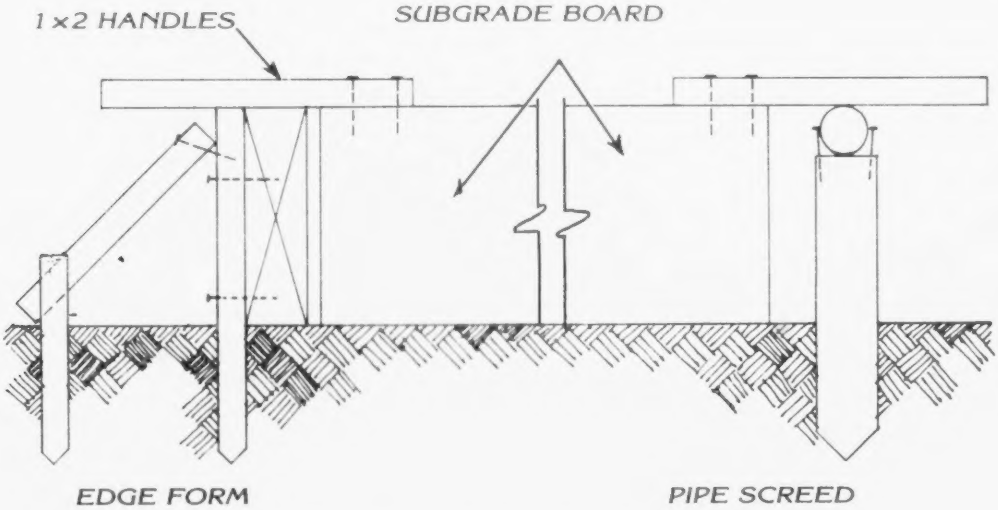

1×2 HANDLES
SUBGRADE BOARD
BRACE

FIGURE 39


1×2 HANDLES
SUBGRADE BOARD
EDGE FORM
PIPE SCREED

N. Clean up area and put away tools and materials

EDGE FORMS
UNIT II

JOB SHEET #2 — CONSTRUCT EDGE FORMS FOR A SLAB ON GRADE WITH FOUNDATION

I. Tools and materials

   A. Tools

      1. Sledgehammer
      2. Claw hammer
      3. Power handsaw and extension cord
      4. Handsaw
      5. One-hundred-foot tape
      6. Folding rule or steel tape
      7. Hand level
      8. String line
      9. Builder's level and rod

   B. Materials

      1. Stakes
      2. Sheathing
      3. 8d and 16d duplex nails
      4. Wire, #9 annealed
      5. Dowels
      6. 1×4s or 2×4s for braces

II. Procedure

   A. Lay sheathing on top of foundation or on ground along wall

   (NOTE: This is to establish the location of support stakes.)

JOB SHEET #2

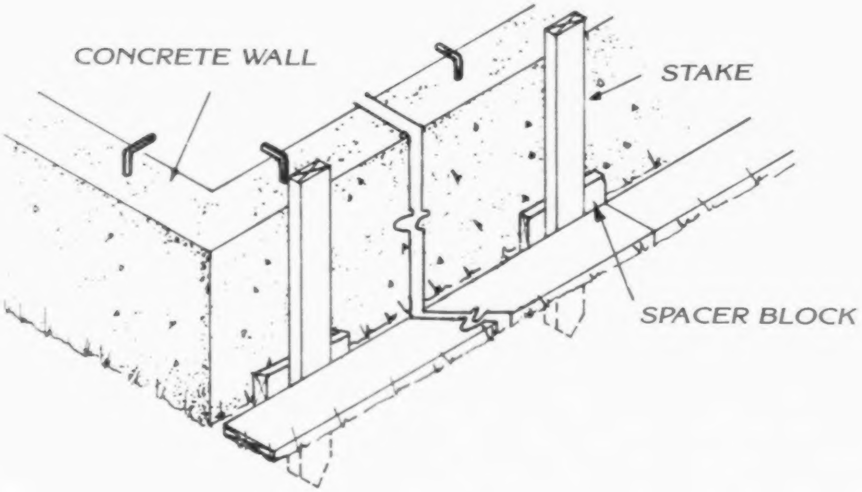
B. Drive support stakes at ends of each sheathing board (Figure 40)

   1. Place a spacer block between stake and wall

   2. Hold stake tightly against spacer block; drive stake

      (NOTE: When driven, the top of the stake should be above the finish slab grade.)

FIGURE 40



C. Establish grade on support stakes

   (NOTE: Use the builder's level to establish grade.)

D. Nail sheathing to stakes (See Figure 41.)

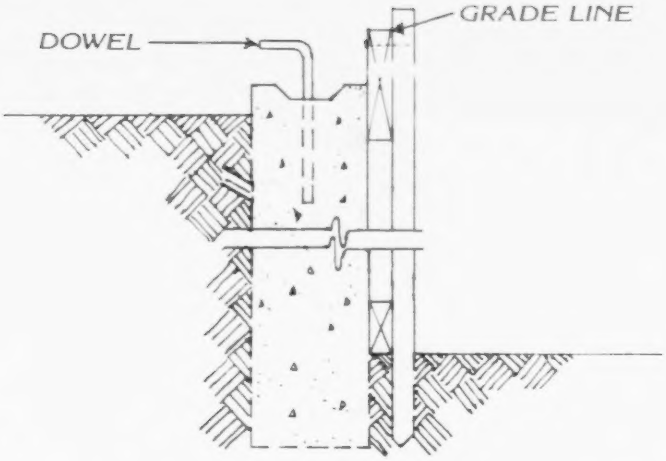
   1. Start nail on inside of sheathing

   2. Position sheathing between stake and wall with top even with grade line

   3. Drive nail through sheathing into the stake

JOB SHEET #2

FIGURE 41



E. Drive intermediate stakes

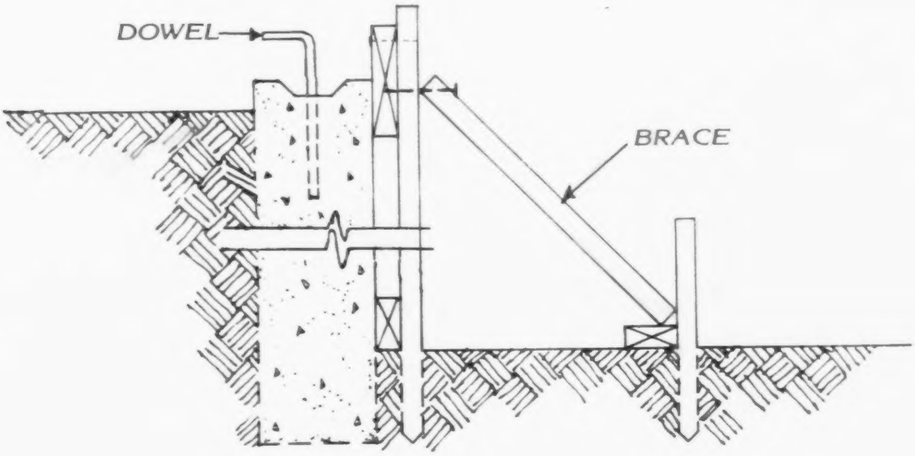
F. Establish grade on intermediate stakes

G. Nail sheathing to intermediate stakes

H. Secure sheathing tightly against the wall (Figures 42 and 43)

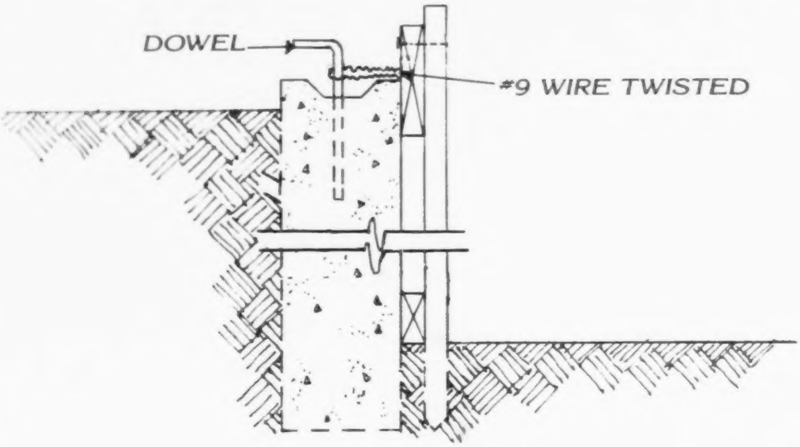
(NOTE: Figures 42 and 43 show alternate methods of holding the form against the wall and plumb. There could be situations where they would both be used on the same form.)

FIGURE 42: Brace method



JOB SHEET #2

FIGURE 43: Tie method



I. Cut stakes off flush with top of edge form on surfaces where straight edge will be used

J. Check work for accuracy and plumb

K. Clean up area and put away tools and materials

EDGE FORMS
UNIT II

JOB SHEET #3 — CONSTRUCT EDGE FORMS FOR A PATIO WITH RADIUS

I. Tools and materials

A. Tools

1. Sledgehammer
2. Claw hammer
3. Power handsaw and extension cord
4. Handsaw
5. One-hundred-foot tape
6. Folding rule or steel tape
7. Hand level
8. String line
9. Builder's level and rod

B. Materials

1. Stakes
2. 2×6s and hardboard for radius
3. 6d box, 8d and 16d duplex nails
4. 1×4s or 2×4s for braces

II. Procedure

A. Locate form lines for the patio (established by instructor)

B. Drive corner line stakes, allowing for thickness of forms

C. Lay out forms for straight sides of patio along this line, keeping ends butted together

D. Establish grade on line stakes

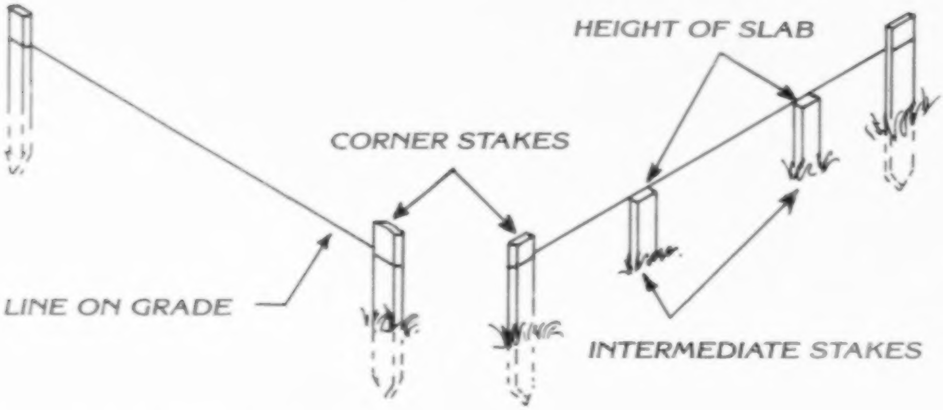
(NOTE: Remember to allow for 1½ inch slope from building to outer edge of patio.)

JOB SHEET #3

E. Secure line to one corner stake on established grade, and stretch line tight to established grade on next corner stake (Figure 44)

(NOTE: Be sure that the line is tight and without sag.)

FIGURE 44

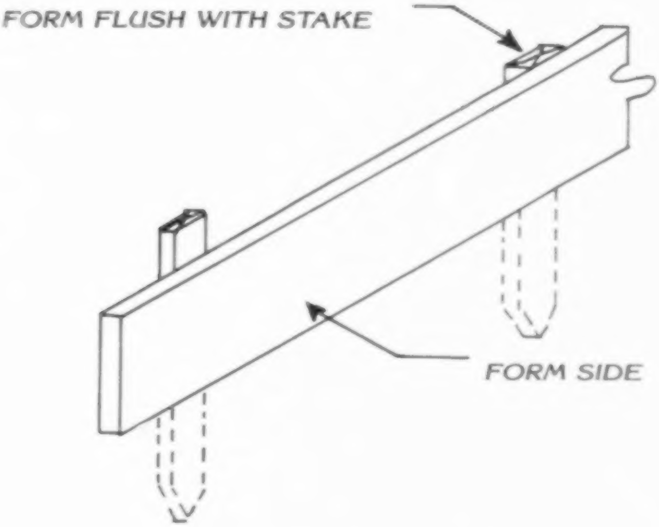

HEIGHT OF SLAB
CORNER STAKES
LINE ON GRADE
INTERMEDIATE STAKES

F. Drive all intermediate stakes

(NOTE: Drive stakes straight down with face of the stakes plumb with line and the top of stake flush with line.)

G. Nail 2×6 sheathing to stakes with top of 2×6s flush with the grade stakes or flush with grade on stakes (Figure 45)

FIGURE 45

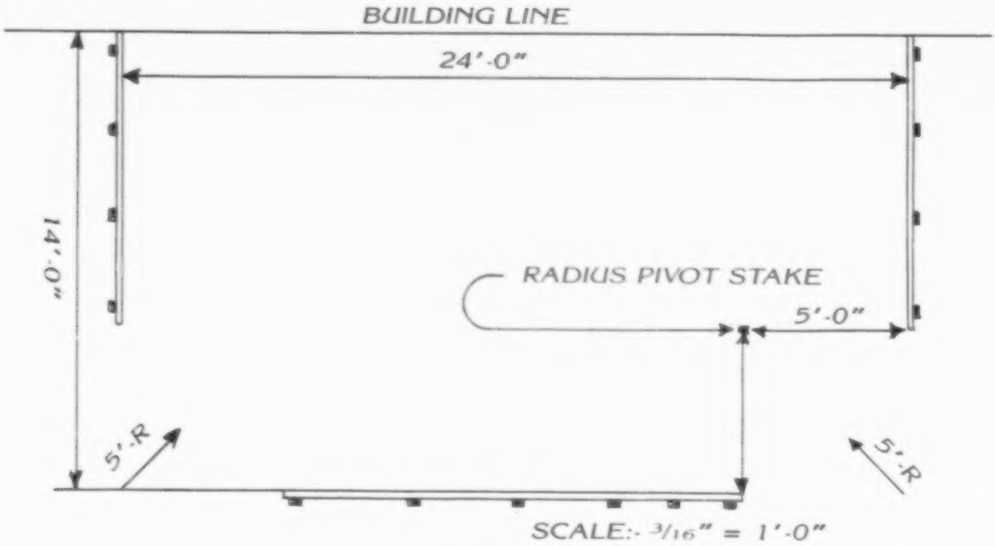

FORM FLUSH WITH STAKE
FORM SIDE

JOB SHEET #3

H. Lay out radius pivot stakes (Figure 46)

1. Measure at right angles from the two forms the correct distance of radius (5′–0″)
2. Drive radius stake where 5-foot marks intersect
3. Check measurements again and drive a nail in stake at exact point where 5-foot measurements intersect

FIGURE 46



4. Use the same procedures to set second radius pivot stake

I. Drive stakes for radius (See Figure 47.)

1. Hook end of tape on nail in pivot stake
2. Stretch tape to both forms and check measurement

   (NOTE: If adjustment is necessary, force the stake over enough to compensate for difference.)

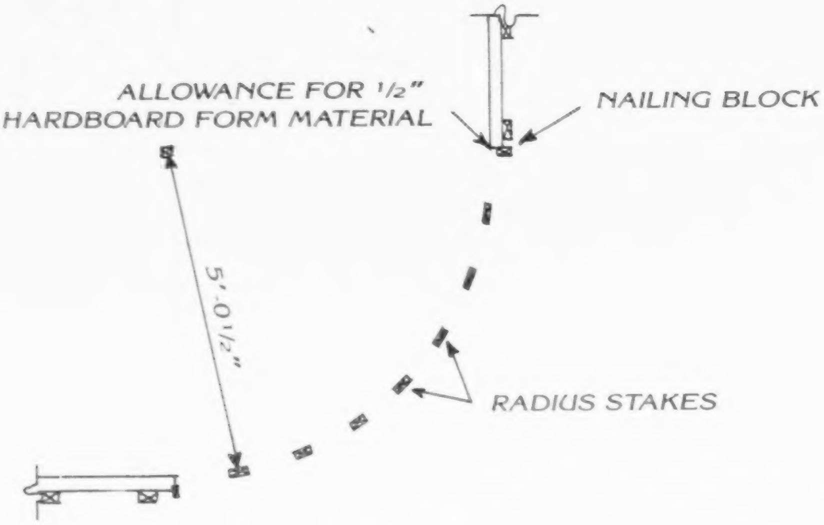
3. Keep tape stretched tight; and move around radius from one form to the other, driving stakes centered about 12 inches apart

   (NOTE: Be sure to allow for thickness of form, and keep stakes straight up and down with the face of stakes flat to the radius.)

4. Use same procedures to drive stakes for second radius

JOB SHEET #3

FIGURE 47


ALLOWANCE FOR 1/2"
HARDBOARD FORM MATERIAL
NAILING BLOCK
5'-0 1/2"
RADIUS STAKES

J. Nail a nailing block on end of each of the straight forms, allowing for thickness of the radius form material (See Figure 47)

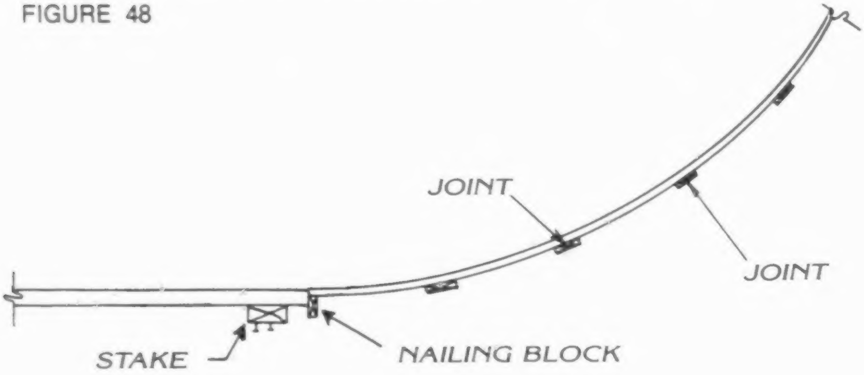
K. Establish grade on the radius stakes

L. Nail hardboard to stakes

(NOTE: With this size radius, use two thicknesses of 1/4-inch hardboard with staggered joints centered on stakes.)

1. Hold the two pieces of hardboard flush on top, and start nailing from nailing block on one of the straight forms (Figure 48)

FIGURE 48


JOINT
JOINT
STAKE
NAILING BLOCK

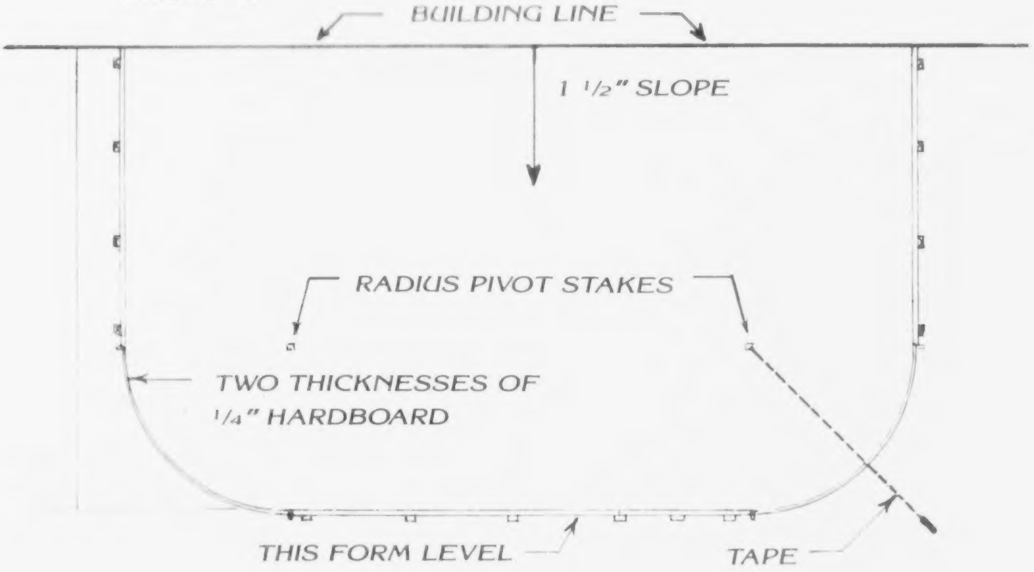
JOB SHEET #3

2. Continue working around radius, keeping top edge of form on grade and adding pieces of hardboard as necessary until radius is complete

   (NOTE: If joints in hardboard do not center on stakes, drive an intermediate stake at joint.)

M. Use same procedures to nail up forms on second radius and check radii with tape (Figure 49)

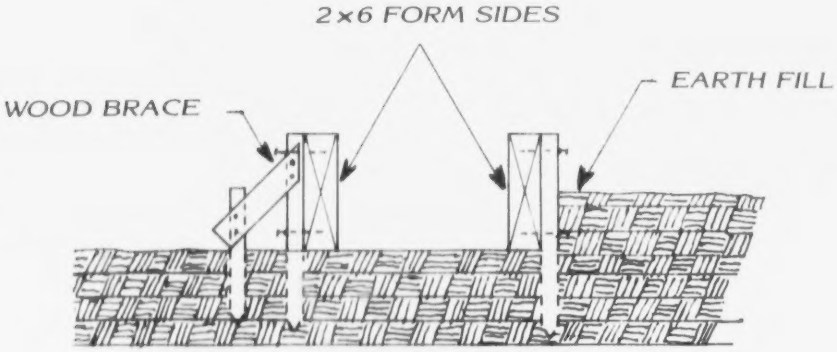
FIGURE 49


BUILDING LINE
1 1/2" SLOPE
RADIUS PIVOT STAKES
TWO THICKNESSES OF 1/4" HARDBOARD
THIS FORM LEVEL
TAPE

N. Brace forms, using one of the methods illustrated in Figure 50

(NOTE: Any stakes sticking up above the forms may be cut off flush with top of form.)

FIGURE 50


2×6 FORM SIDES
WOOD BRACE
EARTH FILL

JOB SHEET #3

O. Check work for accuracy and plumb

P. Clean up area and put away tools and materials

EDGE FORMS
UNIT II

JOB SHEET #4 — CONSTRUCT FORMS FOR A SMALL SET OF STAIRS

I. Tools and materials

  A. Tools

    1. Claw hammer
    2. Handsaw
    3. Power handsaw and extension cord
    4. Sledgehammer
    5. Framing square stair gauges
    6. Framing square
    7. Hand level
    8. Electric drill motor and drills
    9. Folding rule or steel tape

  B. Materials

    1. Plywood side forms
    2. 2×4s for stakes and stiffener
    3. 2×8s for risers
    4. 1×4s for braces
    5. One-half-inch conduit for spreaders
    6. Threaded or smooth rod for ties
    7. 8d and 16d duplex nails

II. Procedure

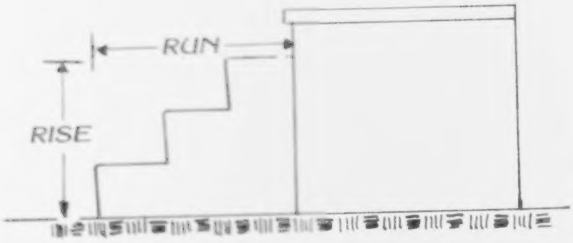
  A. Determine total rise and run

  B. Determine number of risers and number and width of treads

  C. Determine width and length of side form (See Figure 51.)

JOB SHEET #4

FIGURE 51

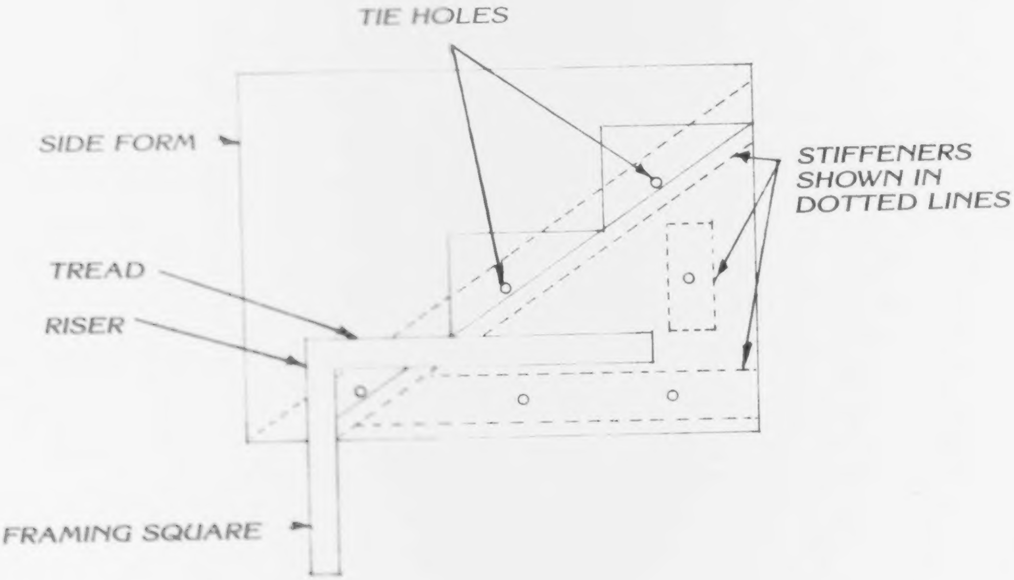


D. Cut forms to size

E. Lay out steps on both forms (Figure 52)

(NOTE: Make a right- and left-hand layout.)

FIGURE 52


TIE HOLES
SIDE FORM
STIFFENERS
SHOWN IN
DOTTED LINES
TREAD
RISER
FRAMING SQUARE

F. Drill tie holes in pattern shown in Figure 52

(NOTE: Place forms back-to-back, and drill both sets of holes at the same time.)

JOB SHEET #4

G. Attach stiffeners to back side of forms centered on tie holes; drill tie holes in stiffeners

H. Cut spreaders to length

(NOTE: Spreaders will be as long as the stair is wide.)

I. Cut threaded rod to length

(NOTE: The rods must be long enough to go through the forms on each side of the stairs with sufficient room for nuts, washers, and a 1-inch projection on each end. See Figure 54.)

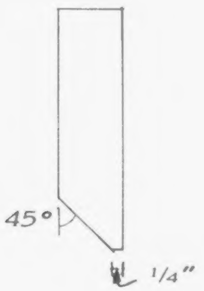
J. Size riser forms

1. Lay out batter of riser on side form to determine exact width
2. Cut riser form to width
3. Cut riser form to length

   (NOTE: Riser form length will be the same as the stair width.)

4. Cut 45-degree angle on bottom edge of tread (Figure 53)

FIGURE 53



K. Assemble side forms

1. Stand side forms on level surface
2. Place washer and nut on one end of each rod
3. Insert rods through holes in one form, through spacer, and then through holes in other form; secure with nut and washer at other end

JOB SHEET #4

4. Snug up nuts to hold forms together

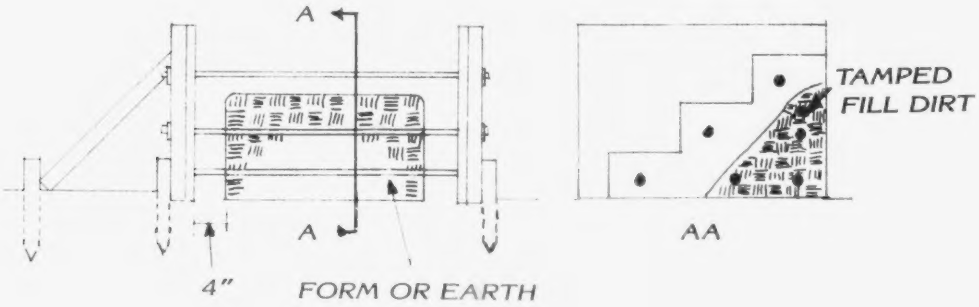
L. Set assembled form in pour location

(NOTE: If a form is to be used under the pour, set it in place first.)

1. Plumb side forms
2. Drive stakes at outside of form sides
3. Raise risers to level position both directions and nail form to stakes

M. Place fill dirt under slab if bottom form is not used (Figure 54)

FIGURE 54



N. Brace as shown in Figure 54

(NOTE: Very little bracing is needed on this type of form.)

O. Check work for accuracy and plumb

P. Clean up area and put away tools and materials

EDGE FORMS
UNIT II

JOB SHEET #5 — CONSTRUCT FORMS FOR EARTH-SUPPORTED STAIRS

I. Tools and materials

  A. Tools

    1. Claw hammer
    2. Handsaw
    3. Power handsaw and extension cord
    4. Sledgehammer
    5. Framing square stair gauges
    6. Hand level
    7. Builder's level
    8. Framing square
    9. Folding rule or steel tape

  B. Materials

    1. Plywood forms
    2. 2×4 stakes
    3. 2×4s for aligners
    4. 2×8s for risers
    5. 2×4s for blocks
    6. 1×4s for braces
    7. 8d and 16d duplex nails

II. Procedure

  A. Determine total rise and run

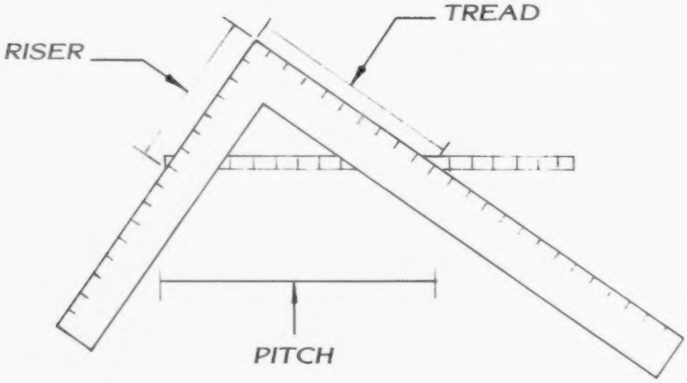
  B. Determine number of risers and number and width of treads

  C. Determine width and length of side form from rise and run (See Figure 55.)

  (NOTE: Form width will be the slab thickness plus the riser height and two inches. Form length will be the length of the pitch of one step times the number of steps in the flight plus 1 foot for overhang.)

JOB SHEET #5

FIGURE 55

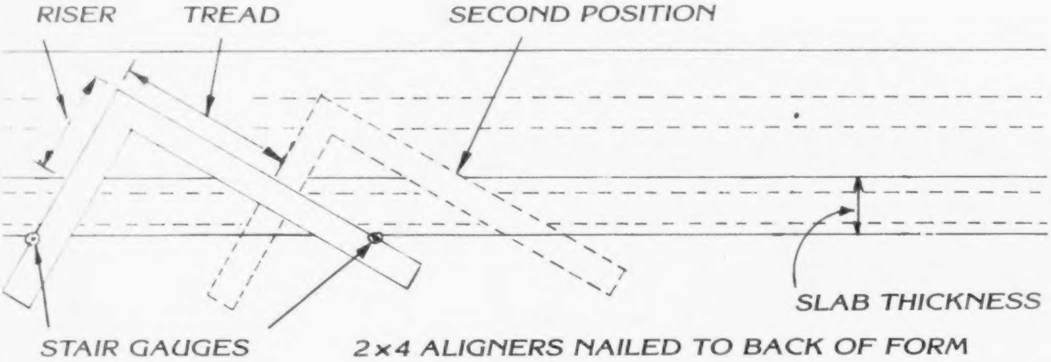

TREAD
RISER
PITCH

D. Cut form sides to size

(NOTE: Form sides may also be made from 1×6 or wider boards cleated together.)

E. Lay out side forms (Figure 56)

FIGURE 56


RISER
TREAD
SECOND POSITION
SLAB THICKNESS
STAIR GAUGES
2×4 ALIGNERS NAILED TO BACK OF FORM

1. Mark a line along the bottom length of the form equal to the slab thickness
2. Lay framing square on form, with riser height and tread width on slab line
3. Attach stair gauges to framing square
4. Mark tread and riser on form
5. Move square to next step and lay out tread and riser

(NOTE: Use a sharp pencil, and follow line intersections accurately.)

JOB SHEET #5

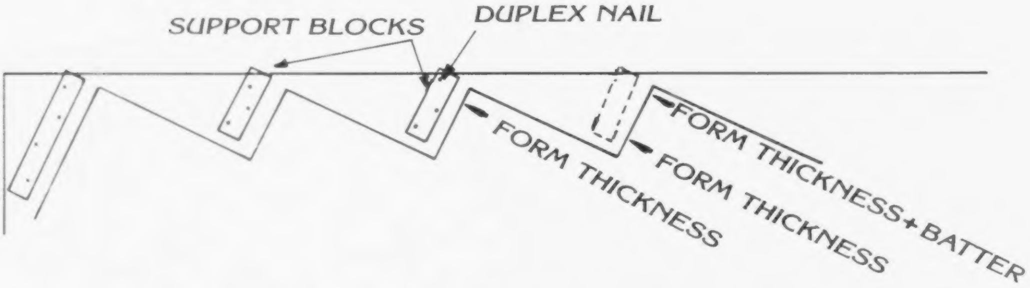
6. Repeat step 5 to complete layout
7. Lay out opposite side form, following steps 1 to 6

   (NOTE: There will be two form sides. The forms will be laid out for right- and left-hand sides.)
8. Nail aligners to form sides

F. Nail riser support blocks to form sides (Figure 57)

(NOTE: For battered riser, add batter dimension to tread length as shown on right-hand riser in Figure 57.)

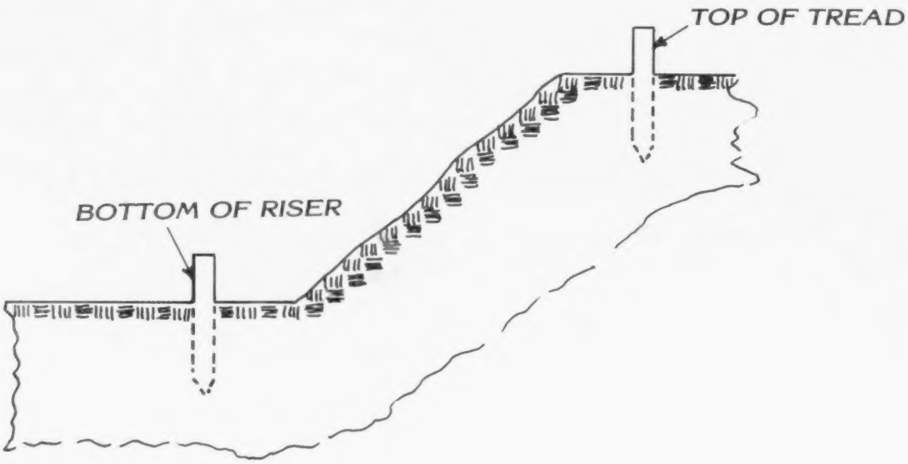
FIGURE 57


SUPPORT BLOCKS
DUPLEX NAIL
FORM THICKNESS
FORM THICKNESS
FORM THICKNESS+BATTER

G. Set grade stakes at top and bottom of flight (Figure 58)

(NOTE: Use builder's level to establish grade from bench mark.)

FIGURE 58


TOP OF TREAD
BOTTOM OF RISER

JOB SHEET #5

H. Drive side form support stakes

(NOTE: Allow for sheathing and aligners when driving stakes.)

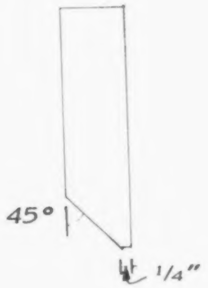
I. Set form sides

1. Set form side against stakes
2. Level over from bottom grade stake to bottom of first riser; adjust form and nail to stake
3. Level over from top grade stake to top tread line; adjust form and nail to stake
4. Nail form to intermediate stakes
5. Repeat steps 1 to 4 to continue erection

J. Size riser forms

1. Cut form material to length
2. Cut riser forms to width
3. Cut bottom of riser form to 45-degree angle (Figure 59)

FIGURE 59



K. Install riser forms

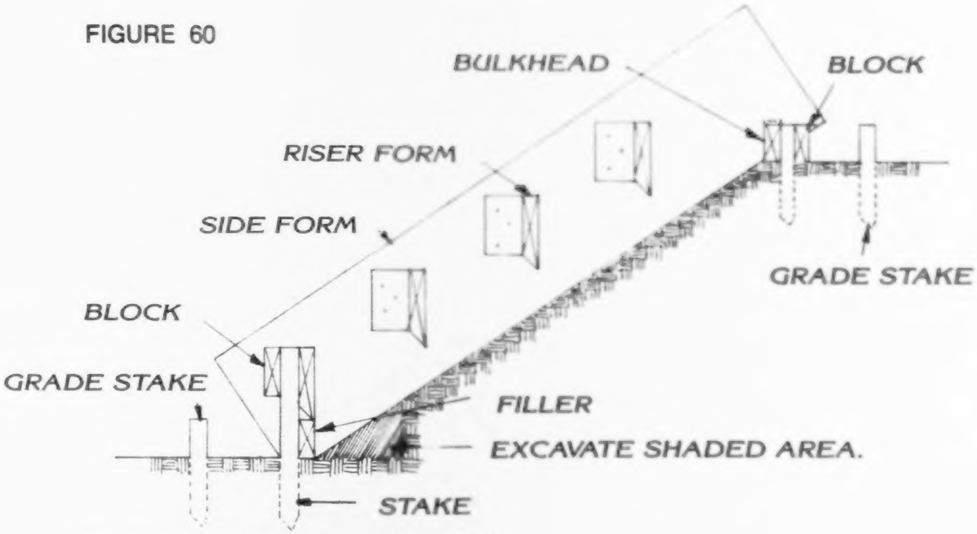
1. Place riser form in position with top of form flush with tread line and against block
2. Nail riser forms from outside of side form, using duplex nails
3. Repeat steps 1 and 2 to continue installation

   (NOTE: If bottom landing slab is not poured at this time, a filler piece the thickness of the slab will have to be installed under the bottom riser form.)

L. Install bulkhead at top tread (See Figure 60.)

JOB SHEET #5

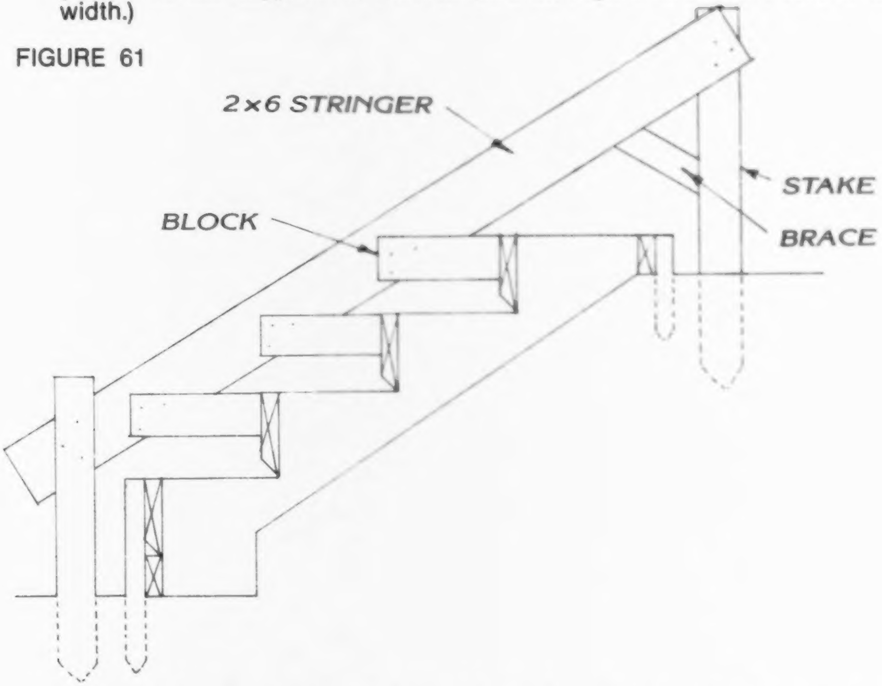
FIGURE 60


BULKHEAD
BLOCK
RISER FORM
SIDE FORM
GRADE STAKE
BLOCK
GRADE STAKE
FILLER
EXCAVATE SHADED AREA.
STAKE

M. Install center support (Figure 61)

(NOTE: Center supports are not needed on flights of stairs 4 feet or less in width.)

FIGURE 61


2×6 STRINGER
STAKE
BLOCK
BRACE

(NOTE: Stringer should be at least 1 inch above the riser to allow work room.)

N. Check work for square and plumb

O. Clean up area and put away tools and materials

EDGE FORMS
UNIT II

JOB SHEET #6 — CONSTRUCT FORMS FOR SUSPENDED STAIRS

I. Tools and materials

A. Tools

1. Claw hammer
2. Handsaw
3. Power handsaw and extension cord
4. Hand level
5. Builder's level and rod
6. Framing square
7. Folding rule or steel tape
8. Framing square stair gauges

B. Materials

1. Plywood for side forms and decking
2. 2×4s for stakes, aligners, and blocks
3. 1×4s for braces
4. 4×4s for shores, horses, joist, and stringers
5. 1½"×4"×10" for wedges
6. 2×8s for risers

II. Procedure

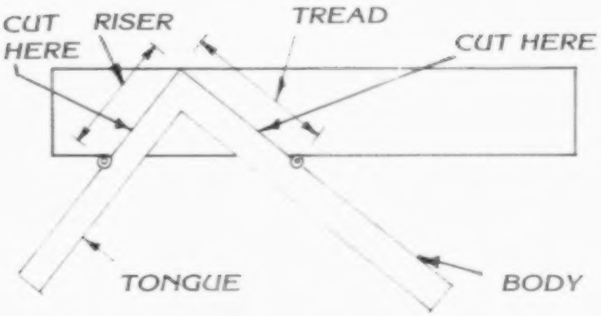
(NOTE: These forms are for stairs open at the sides.)

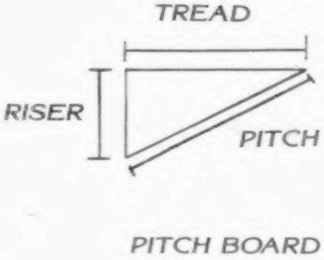
A. Make a pitch board (See Figure 62.)

1. Attach stair gauges to square to correspond to rise and run of a stair unit
2. Place square on a thin board; mark and cut as shown in Figure 62

JOB SHEET #6

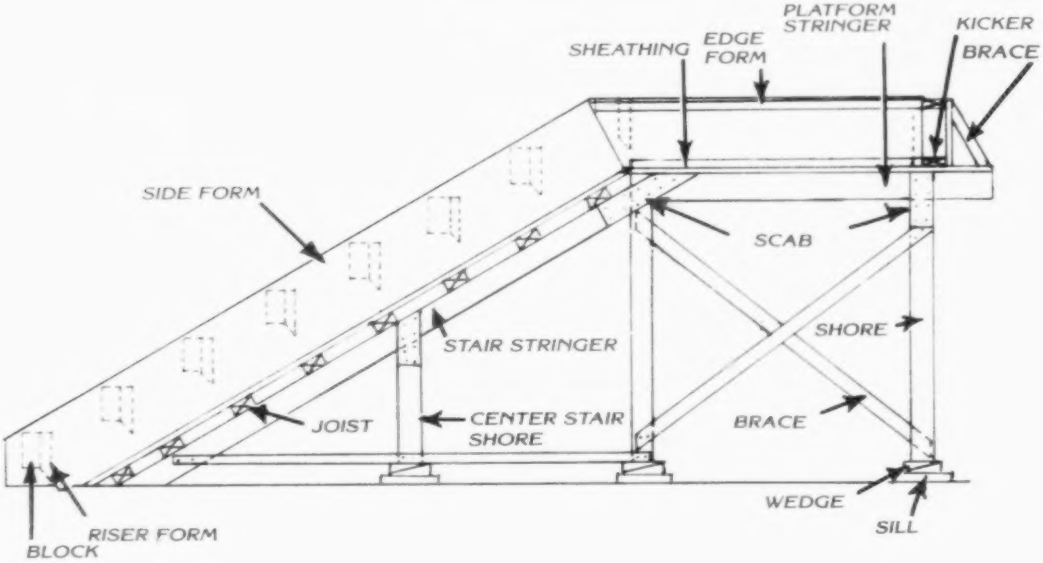
FIGURE 62


CUT HERE
RISER
TREAD
CUT HERE
TONGUE
BODY


TREAD
RISER
PITCH
PITCH BOARD

B. Cut form pieces to size (Figure 63)

FIGURE 63


PLATFORM STRINGER
KICKER
BRACE
EDGE FORM
SHEATHING
SIDE FORM
SCAB
SHORE
STAIR STRINGER
JOIST
CENTER STAIR SHORE
BRACE
WEDGE
SILL
RISER FORM
BLOCK

1. Obtain shore length by subtracting decking, stringer, sill, and wedge thicknesses from bottom of slab height

2. Project stringers past platform a distance equal to height of edge form

3. Cut side forms to width

   a. Use the pitch board

JOB SHEET #6

   - b. Measure the step and slab thickness on a line 90 degrees to the pitch
   - c. Add 2 inches to determine width at intersection of tread and riser

4. Frame beam sides
   - a. Measure length of pitch on pitch board
   - b. Multiply by the number of treads
   - c. Add 1 foot to determine length

5. Cut joist to length by determining width of slab plus height of two side forms

6. Cut edge forms the same width as the slab thickness

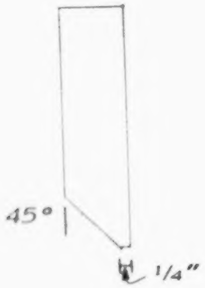
7. Cut stringer scabs by laying pitch board on material with pitch side flush with bottom; cut on the tread side

8. Cut stringer blocks by laying pitch board on edge of material with pitch side flush with bottom; cut on the riser side

9. Size riser forms
   - a. Cut to riser height
   - b. Cut to stair width
   - c. Cut 45-degree bevel on bottom edge (Figure 64)

     (NOTE: When pouring a rough stair, it is not necessary to cut the bottom of the riser form at a 45-degree angle.)

FIGURE 64

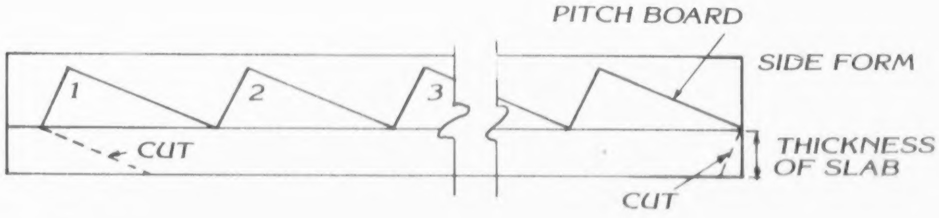


C. Lay out beam sides (See Figure 65)

(NOTE: Two beam sides are needed, one right-hand and one left-hand.)

JOB SHEET #6

FIGURE 65

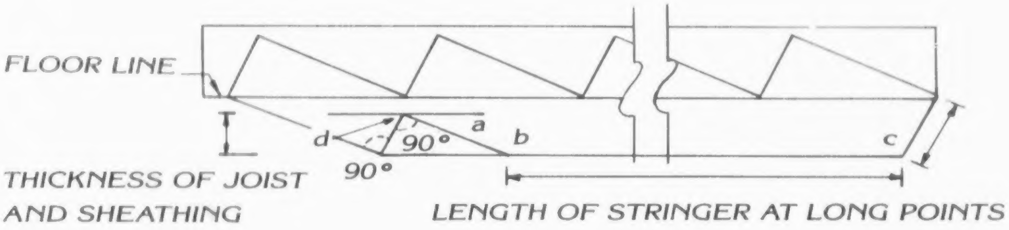

PITCH BOARD
SIDE FORM
1
2
3
CUT
THICKNESS OF SLAB
CUT

1. Scribe a pencil line on the form equal to thickness of slab
2. Lay pitch side of pitch board on line and mark tread and riser position #1 as illustrated in Figure 65, allowing for thickness of riser form
3. Move pitch board to position #2 and mark tread and riser

   (NOTE: Intersect all lines accurately. Use a sharp pencil.)
4. Repeat step 3 to lay out step #3 and all other steps in the flight
5. Lay out and cut ears as shown by dotted lines in Figure 65

D. Lay out and cut stringers; determine length (Figure 66)

FIGURE 66


FLOOR LINE
THICKNESS OF JOIST AND SHEATHING
d
90°
a
b
90°
c
LENGTH OF STRINGER AT LONG POINTS

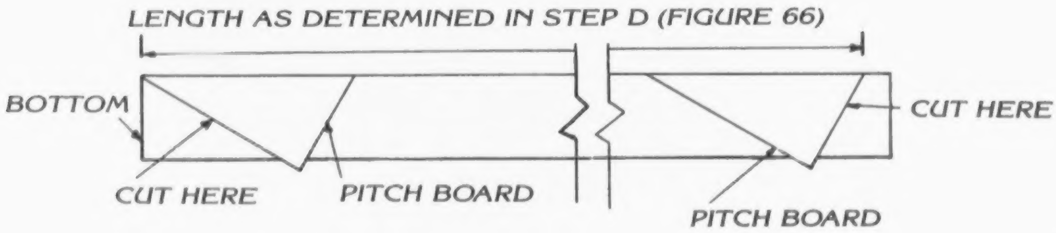
1. Scribe a line equal to thickness of joist and sheathing, establishing line *a*
2. Square from intersection of floor line and bottom of side form to intersect with line *a*
3. Square from this line to make point *b* intersect with bottom edge of form
4. Measure from point *b* to point *c* to determine length of stringer
5. Lay out this length on stringer

   (NOTE: These are the long points of the stringer.)

JOB SHEET #6

6. Lay out top and bottom cuts (Figure 67)

FIGURE 67


LENGTH AS DETERMINED IN STEP D (FIGURE 66)
BOTTOM
CUT HERE
PITCH BOARD
CUT HERE
PITCH BOARD

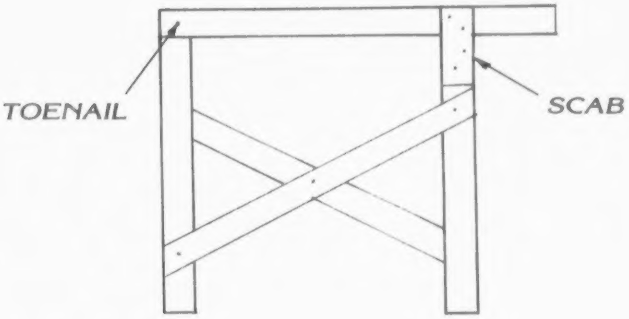
7. Cut on lines as shown in Figure 67

E. Erect shores and stringers

1. Nail two shores to each stringer and cross brace as shown in Figure 68

(NOTE: Place a block the thickness of the shore between braces to nail crossing point.)

FIGURE 68


TOENAIL
SCAB

2. Lay sills on floor at location of shores
3. Tack wedges to sill at shore locations
4. Stand end shores upright; tack spacer board across top; cross brace
5. Install crossmembers between shores

F. Install stringers

1. Tack top of the stringer to shore

(NOTE: Measure length of line d in Figure 66 from top of decking to determine location.)

JOB SHEET #6

2. Nail cleat across stringers and shore
3. Repeat steps 1 and 2 to complete erection

G. Nail joist to stringers, spacing as needed to allow a uniform overhang on each side

H. Nail decking to joist and stringers, using a minimum of nails to hold decking in place

I. Lay out sides of stair and landing, dropping a plumb bob from edge of stair hole to establish lines

J. Install side forms and edge forms

(NOTE: Form oil must be applied before rebars are installed.)

1. Nail a continuous kicker to deck

   (NOTE: Kicker will be placed the thickness of the riser forms back from layout lines.)

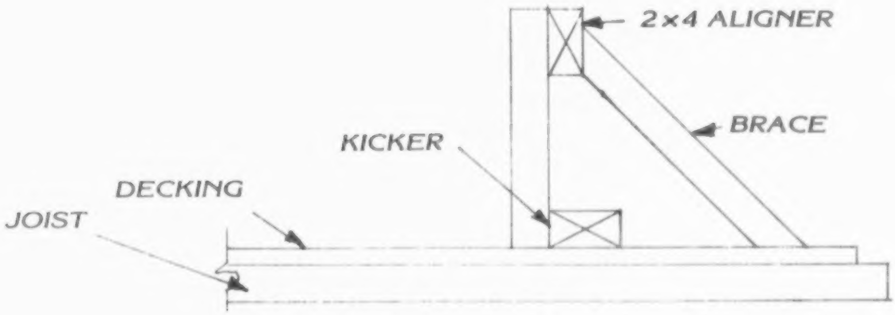
2. Stand forms upright on deck, and nail to kicker

K. Install riser form

1. Hold riser form on riser layout line
2. Nail through form side with duplex nails

L. Install aligner and brace beam sides (Figure 69)

FIGURE 69



M. Install blocks at risers

(NOTE: Blocks are not needed if the tread form material is thick, solid lumber.)

N. Check work for square and plumb

O. Clean up work area and put away tools and materials

EDGE FORMS
UNIT II

TEST

NAME ____________________________________ SCORE ________________

1. Match terms associated with edge forms to their correct definitions. Write the correct number in the blanks.

______a. Vertical part of a stair step

______b. Low form placed at the perimeter of a slab

______c. Receding upward slope of the face of a form

______d. Type of fiberboard made from wood fibers

______e. Distance from floor to top of a landing or to next floor

______f. Wood block used as a pattern to lay out steps and to support treads and risers

______g. Horizontal part of a stair step

______h. Soil prepared and compacted to support a structure or pavement system

______i. Piece of material nailed across a splice to hold both pieces together to help strengthen the joint

______j. Horizontal distance between first riser and face of platform or stair opening above

______k. Device attached to a framing square to ensure accuracy when laying out material, such as stairs and rafters

1. Hardboard
2. Riser
3. Subgrade
4. Pitch board
5. Unit run
6. Edge form
7. Battered
8. Scab
9. Unit rise
10. Stair gauge
11. Tread

2. Name four types of pours using edge forms.

a. ____

b. ____

c. ____

d. ____

TEST

3. Name materials used for edge forms.

a. ____________________

b. ____________________

c. ____________________

4. Identify parts of the edge forms illustrated. Write the correct letters in the blanks.

a. Form without wall

_____ 1) Sheathing

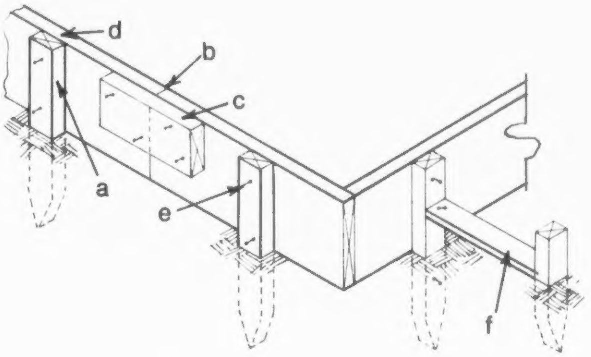
_____ 2) Stake

_____ 3) Duplex nail

_____ 4) Scab

_____ 5) Brace

_____ 6) Joint



b. Form with wall

_____ 1) Sheathing

_____ 2) Stake

_____ 3) Duplex nail

_____ 4) Scab

_____ 5) Brace

_____ 6) Support block

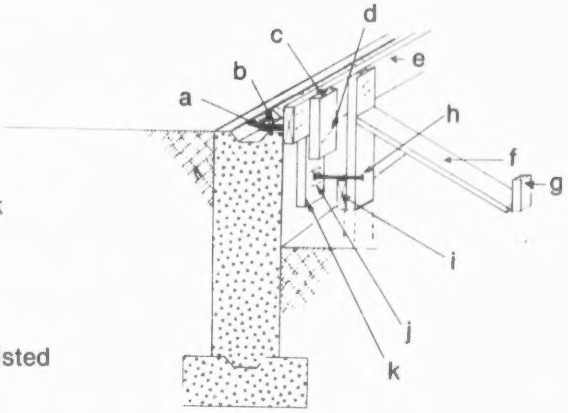
_____ 7) Spacer block

_____ 8) Form tie

_____ 9) #9 tie wire twisted

_____10) Kicker

_____11) Block



TEST

5. Match terms associated with joints to their correct definitions. Write the correct numbers in the blanks.

______a. Waterproof material used as a sealant

______b. Type of isolation joint

______c. Any of various sealing agents

______d. Tool used to cut grooves in concrete

______e. Pertaining to a crack occurring crosswise in slab or pavement

______f. Separation or cut made in concrete for a specific purpose

______g. Joint cut into concrete to control and induce cracking at a particular point; also used to control transverse and longitudinal movement, and to divide concrete into suitable spacings

______h. Preformed, compressible material used to separate units of concrete to prevent damage due to expansion

______i. Tool used to apply caulk

______j. Joint placed lengthwise in slab or pavement

______k. Type of control joint

______l. Joint placed to isolate one section of concrete from another and to isolate concrete from other rigid objects

______m. Planned or emergency joint placed where pour is temporarily suspended

______n. Joint placed in sidewalks, patios, and other slabs strictly for design

______o. Control joint placed obliquely across a slab or pavement

1. Expansion joint
2. Jointer
3. Contraction joint
4. Expansion material
5. Transverse
6. Longitudinal joint
7. Caulk
8. Isolation joint
9. Joint
10. Sealant
11. Skewed joint
12. Control joint
13. Caulking gun
14. Construction joint
15. Dummy joint

6. Name two reasons for using joints in pavements.

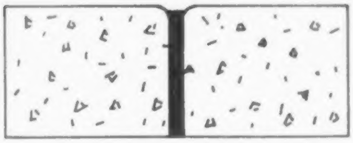
a. ____

b. ____

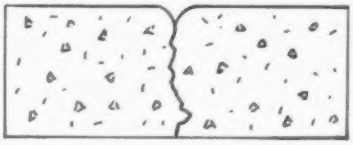
TEST

7. Identify the following types of joints used in pavements. Write the correct names in the blanks.

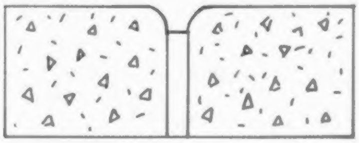
Tooled dummy joint
Tooled control joint
Open joint for filling
Sawed control joint
Tooled construction joint with expansion material
Sawed contraction joint with steel dowel
Tooled isolation joint held down for sealant
Decorative joint with wood spacer



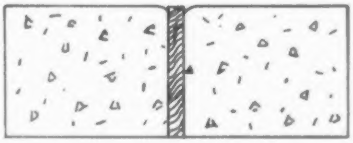
a. ______________________________



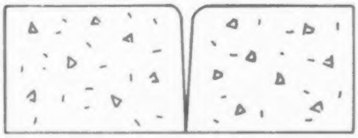
b. ______________________________



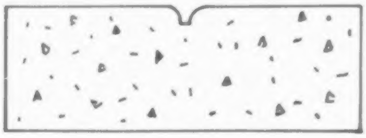
c. ______________________________



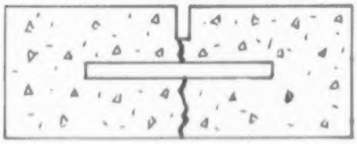
d. ______________________________



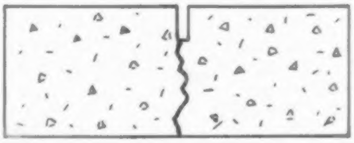
e. ______________________________



f. ______________________________



g. ______________________________



h. ______________________________

TEST

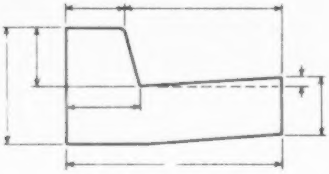
8. List types of sealants used in joints.

   a. ______________________________

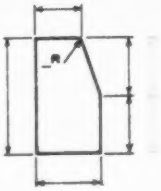
   b. ______________________________

9. Identify the following types of curbs and curb and gutters illustrated. Write the correct names in the blanks.

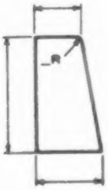
Fully battered curb	**Single-radius curb and gutter, vertical**
Straight curb	**Straight-face curb and gutter, battered**
Roll-type curb and gutter	**Partially battered curb**



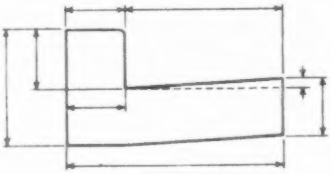
a. ______________________________



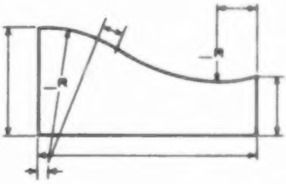
b. ______________________________



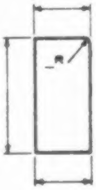
c. ______________________________



d. ______________________________



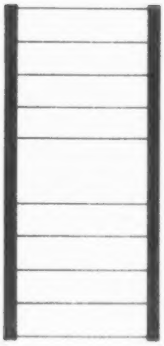
e. ______________________________

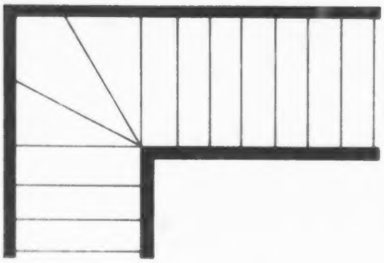


f. ______________________________

TEST

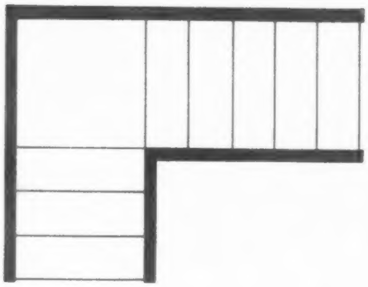
10. Label the types of stairs illustrated below. Write the correct names in the blanks.

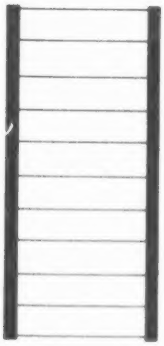




a. ______________________

b. ______________________





c. ______________________

d. ______________________

TEST

11. Identify parts of the stair form illustrated below. Write the correct numbers in the blanks.

_____a. Stair stringer

_____b. Joist

_____c. Block

_____d. Riser form

_____e. Side form

_____f. Sheathing

_____g. Edge form

_____h. Brace

_____i. Platform stringer

_____j. Shore

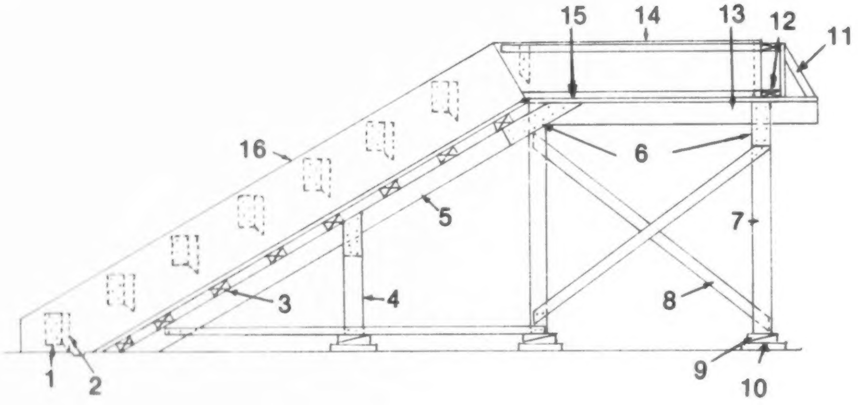
_____k. Wedge

_____l. Sill

_____m. Scab

_____n. Kicker

_____o. Center stair shore



12. Name types of stair slabs.

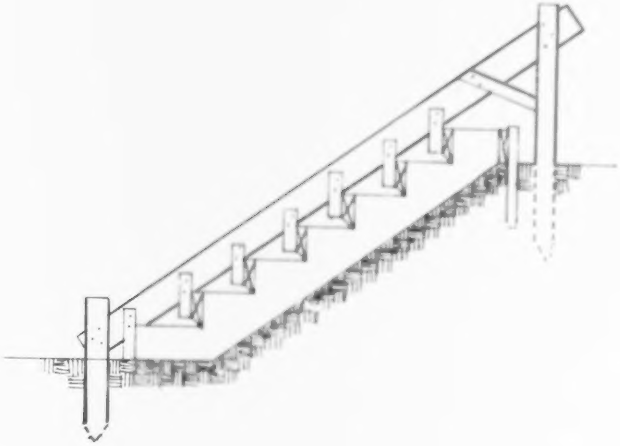
a. ______________________________

b. ______________________________

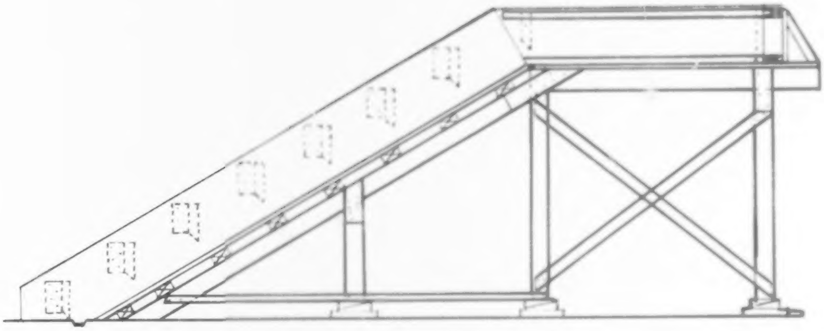
TEST

13. Identify the following stair forms for each type of slab. Write the correct names in the blanks.

Suspended, open on sides	**Earth-supported between walls**
Suspended between walls	**Earth-supported, open on sides**

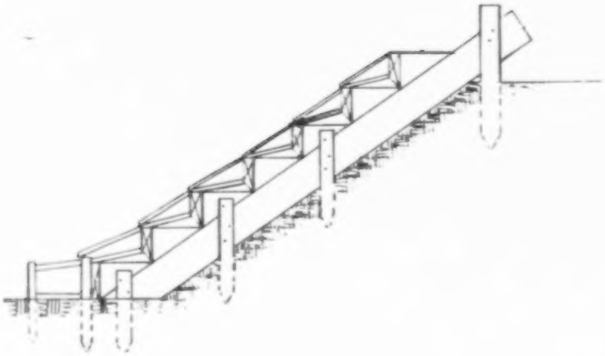


a. ______________________________

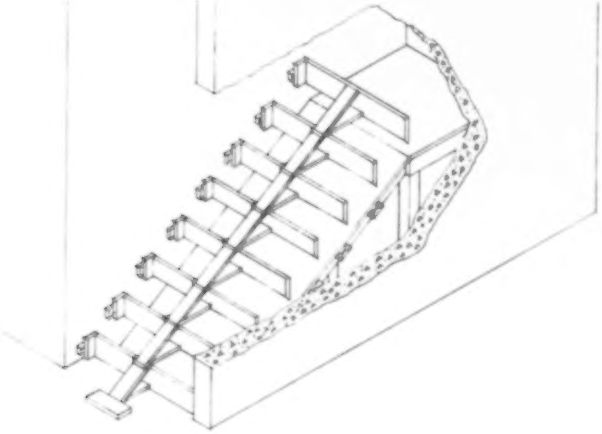


b. ______________________________

TEST



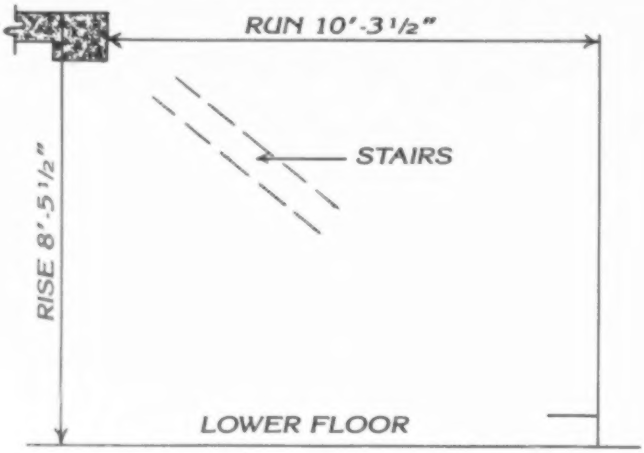
c. ______________________________



d. ______________________________

TEST

14. State rules for unit rise and unit run. Complete the statements below.
    a. Total of one riser and one tread should be not less than ____________ inches or more than ____________ inches.
    b. Unit rise should be ____________ inches to ____________ inches.
    c. Unit run should be ____________ inches to ____________ inches.
    d. Treads and risers *must* be ____________ ____________ ____________ as other treads and risers for any given set of stairs.
15. Calculate number and height of risers and number and width of treads for the stair illustrated below. Write the correct numbers in the blanks.
    a. Number of risers = ____________ Height of risers = ____________
    b. Number of treads = ____________ Width of treads = ____________



(NOTE: Test question 16 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

16. Demonstrate the ability to
    a. Construct edge forms for a slab on grade without foundation.
    b. Construct edge forms for a slab on grade with foundation.
    c. Construct edge forms for a patio with radius.
    d. Construct forms for small set of stairs.
    e. Construct forms for earth-supported stairs.
    f. Construct forms for suspended stairs.

EDGE FORMS
UNIT II

ANSWERS TO TEST

1. a. 2
   b. 6
   c. 7
   d. 1
   e. 9
   f. 4
   g. 11
   h. 3
   i. 8
   j. 5
   k. 10

2. Answer should include any four of the following
   a. Footings
   b. Floor with foundation
   c. Floor without foundation
   d. Stoop, porch, or patio
   e. Sidewalk
   f. Driveway and approach
   g. Curb or curb and gutter
   h. Steps

3. a. Wood
   b. Metal
   c. Hardboard

4. a. 1) d
      2) a
      3) e
      4) c
      5) f
      6) b

   b. 1) e
      2) g
      3) d
      4) c
      5) f
      6) k
      7) i
      8) h
      9) b
      10) a
      11) j

5. a. 7
   b. 1
   c. 10
   d. 2
   e. 5
   f. 9
   g. 12
   h. 4
   i. 13
   j 6
   k. 3
   l. 8
   m. 14
   n. 15
   o. 11

6. Answer should include any two of the following
   a. To control transverse and longitudinal cracking
   b. To control slab movement
   c. To divide pavement into suitable spacings

7. a. Tooled construction joint with expansion material
   b. Tooled control joint
   c. Tooled isolation joint held down for sealant
   d. Decorative joint with wood spacer
   e. Open joint for filling
   f. Tooled dummy joint

ANSWERS TO TEST

- g. Sawed contraction joint with steel dowel
- h. Sawed control joint

8. a. Elastomers
   b. Mastics

9. a. Straight-face curb and gutter, battered
   b. Partially battered curb
   c. Fully battered curb
   d. Single-radius curb and gutter, vertical
   e. Roll-type curb and gutter
   f. Straight curb

10. a. Straight flights with landing
    b. Ninety-degree flights with winders
    c. Ninety-degree flights with landing
    d. Straight flight

11. a. 5
    b. 3
    c. 1
    d. 2
    e. 16
    f. 15
    g. 14
    h. 8, 11
    i. 13
    j. 7
    k. 9
    l. 10
    m. 6
    n. 12
    o. 4

12. a. Suspended
    b. Earth-supported

13. a. Earth-supported between walls
    b. Suspended, open on sides
    c. Earth-supported, open on sides
    d. Suspended between walls

14. a. 16, 18
    b. 7, 8
    c. 9, 11
    d. The same size

15. a. Risers — 14 risers of 7¼ inches each
    b. Treads — 13 treads of 10¼ inches each

16. Performance skills evaluated to the satisfaction of the instructor

FLOOR AND SILL FRAMING
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to identify floor and sill framing members and should be able to estimate materials and build floors and sills. The student will show this knowledge by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with floor and sill framing.
2. Identify floor and sill framing and support members.
3. Name methods used to fasten sills to the foundation.
4. Select from a list types of girders.
5. Determine proper girder size for safe use.
6. List types of joists.
7. Determine proper joist size for ordinary load conditions.
8. Identify types of bridging.
9. List types of subflooring materials.
10. Discuss functional designs used to lay subflooring.
11. List the purposes of subflooring.
12. Match fasteners used in floor framing to their correct uses.
13. Estimate the amount of material needed to frame a floor and sill and to lay a subfloor.
14. Demonstrate the ability to
    a. Build a box sill, install floor joists, and frame an opening.
    b. Install bridging.
    c. Lay diagonal and right-angle subfloors.
    d. Install joists for a cantilever floor.

FLOOR AND SILL FRAMING
UNIT I

SUGGESTED ACTIVITIES

I. Unit contents

  A. Objective sheet

  B. Suggested activities

  C. Transparency Master #1 — Types of Joist Hangers

  D. Information sheet

  E. Assignment sheets

    1. Assignment Sheet #1 — Determine Proper Girder Size for Safe Use

    2. Assignment Sheet #2 — Determine Proper Joist Size for Ordinary Load Conditions

    3. Assignment Sheet #3 — Estimate the Amount of Material Needed to Frame a Floor and Sill and to Lay a Subfloor

  F. Answers to assignment sheets

  G. Job sheets

    1. Job Sheet #1 — Build a Box Sill, Install Floor Joists, and Frame an Opening

    2. Job Sheet #2 — Install Bridging

    3. Job Sheet #3 — Lay Diagonal and Right-Angle Subfloors

    4. Job Sheet #4 — Install Joists for a Cantilever Floor

  H. Test

  I. Answers to test

II. Instructor's guide

  A. Review unit and plan presentation.

  B. Obtain materials needed to supplement instruction.

  C. Introduce unit.

SUGGESTED ACTIVITIES

SUGGESTIONS:

- Discuss framing and the skills required; review fundamentals according to the needs of your class, emphasizing the various types of saw cuts and methods of nailing, such as end, face, and toenailing.
- Relate floor and sill framing to material previously covered on foundations, stressing that no matter how good the foundation is, a structure will not stand if the floors and sills are poorly assembled.
- Provide the class with articles, brochures, and photographs of building damage that resulted from defective floor and sill framing.

  (NOTE: Architectural engineering publications and organizations can provide such materials regarding inadequate joists, girders, etc. Pest exterminators often have information on termite damage and wood rot.)

D. Provide students with objective sheet.

E. Discuss objective sheet, relating the objectives to residential carpentry and to your introduction.

F. Provide students with information sheet.

G. Discuss information sheet.

1. Use Information Sheet, Section I to discuss terms associated with floors and sills.

   SUGGESTIONS:

   - Show students actual samples of listed materials whenever possible.

     EXAMPLES: Anchor bolts, steel bridging, sill sealer

   - Relate terms to the objectives, such as making a connection between the term *span* and the objectives on determining proper girder and joist size.
   - Review defects in lumber as discussed in *Fundamentals of Carpentry* when you discuss *crown*. Emphasize the need for solid, sturdy, straight lumber in floor and sill framing, especially for satisfying the requirements of load capacities.

2. Use Information Sheet, Section II to discuss floor and sill framing and support members.

SUGGESTED ACTIVITIES

SUGGESTIONS:

- Make a model showing floor and sill framing; construct the model in such a way that students can disassemble and reassemble it.
- Tour a construction site where the floors and sills are being framed.
- Emphasize the function of each part and introduce the class to the concepts of tables to compute structural load limits and member sizes.
- Relate concepts about the design of footings and foundations studied in previous units to the design of floors and sills.

3. Use Information Sheet, Section III to discuss methods of fastening sills to the foundation.

   SUGGESTIONS:

   - Show actual samples of the hardware for each method and discuss possible reasons for choosing one over another, especially in specific applications.
   - Emphasize safety and the need for certification in the use of powder-actuated fasteners.

4. Use Information Sheet, Sections IV and V to discuss types of girders and how to determine the proper size girder for safe use.

   SUGGESTIONS:

   - Show the class samples of each type of girder and introduce the students to girder size tables for each type.
   - Provide the students with plans specifying the different types of girders, or tour construction sites where various types of girders are being used; discuss reasons for using each type.
   - Demonstrate the procedures for determining girder size and allow the students to practice by completing Assignment Sheet #1.
   - Review local building codes that affect girder size, use, and materials.
   - Motivate the students by emphasizing that plans usually specify girder sizes, but that the sizes must often be adjusted for local regulations, changes requested by the owners, site conditions, and other factors; also point out that often residential carpenters work on remodelling projects without benefit of engineering prints.

SUGGESTED ACTIVITIES

5. Use Information Sheet, Section VI to discuss types of joists.

   SUGGESTIONS:

   - Provide the class with samples of each type of joist and discuss reasons for using each type, emphasizing local practices.
   - Discuss lumber sizes and lengths that are commonly available.
   - Invite a materials supplier who handles various types of joists to discuss costs, sizes available, time required for special orders, etc.
   - Discuss local regulations affecting joists and floor and sill framing.

6. Use Information Sheet, Section VII to discuss how to determine proper joist size for ordinary load conditions.

   SUGGESTIONS:

   - Demonstrate the procedure for determining proper joist size, emphasizing the variables in the procedure and how changing any of them affects the load capacity; point out, for example, that a smaller size joist can be used if the span is shortened or the spacing made closer.
   - Allow students to complete Assignment Sheet #2.
   - Have the students make cost comparisons of equivalent load-bearing joists, for example, to carry a 40-pound live load over a 16-foot span.
   - Use blueprints to show different ways of handling joist layouts.
   - Demonstrate the procedures in Job Sheets #1 and #4 and allow the students to practice the procedures at a job site or at the training facility.

7. Use Information Sheet, Section VIII to discuss types of bridging.

   SUGGESTIONS:

   - Show samples of each type of bridging and discuss reasons for its use.
   - Invite a framing carpenter to talk to the class about the types of bracing.
   - Discuss spacing, nailing, and other features of bridging installation; use manufacturers' literature to cover steel bridging.
   - Demonstrate the procedures in Job Sheet #2 and allow the students to practice the procedures.

SUGGESTED ACTIVITIES

8. Use Information Sheet, Sections IX through XI to discuss types of subflooring materials, functional designs, and purposes of subflooring.

   SUGGESTIONS:

   - Show samples of each type of flooring and discuss reasons for using each type.
   - Discuss standard sizes, layout, nailing, and other factors involved in subflooring, including local regulations.
   - Invite flooring specialists such as carpet layers and tile setters to discuss subflooring requirements for various types of finish flooring.
   - Demonstrate the procedures in Job Sheet #3 and allow students to practice laying various types of subflooring.
   - Ask students with carpentry experience to discuss the purposes of subflooring, giving examples of each purpose and discussing how subflooring satisfies those purposes.

9. Use Information Sheet, Section XII to discuss types of fasteners used in floor framing.

   SUGGESTIONS:

   - Show the class samples of each type of fastener.
   - Allow the students to practice with any fasteners, including adhesives, not used in the job sheets and related projects.

10. Use Information Sheet, Section XIII to discuss estimating materials for floor and sill framing.

    SUGGESTIONS:

    - Use plans to discuss estimating.
    - Allow students to complete Assignment Sheet #3.
    - Compare costs of material and labor for various types and sizes of joists, girders, and subflooring for a single job.
    - As much as possible, allow students to determine estimate, and order materials for all projects.

H. Review unit.

I. Give test.

SUGGESTED ACTIVITIES

J. Critique and discuss test in class.

K. Reteach and retest as required.

L. Complete appropriate sections of competency profiles.

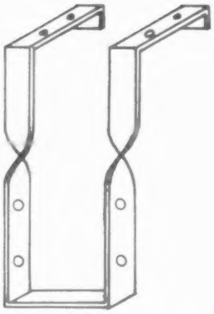
III. Unit references

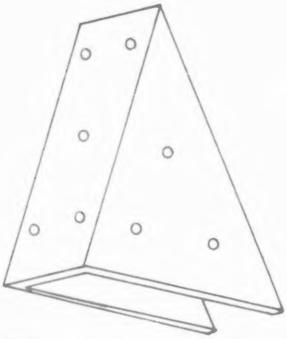
A. Hendrix, Laborn J. "Bud." *Commercial Carpentry*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1979.

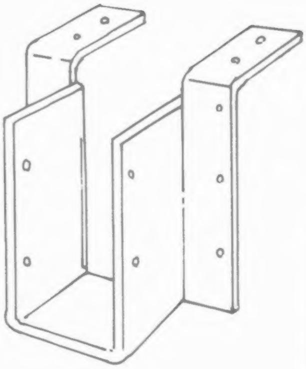
B. Penner, Wayman R. *Residential Carpentry*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1973.

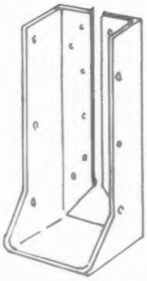
C. Wagner, Willis H. *Modern Carpentry*. New Holland, Illinois: Goodheart-Willcox, 1976.

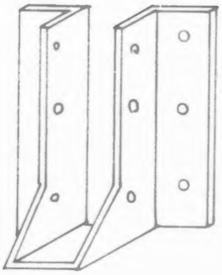
Types of Joist Hangers

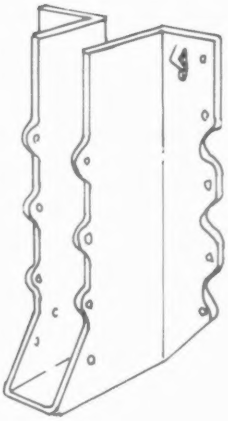


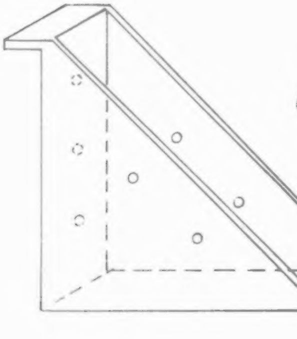


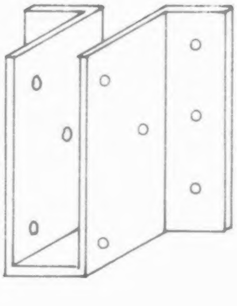












FLOOR AND SILL FRAMING
UNIT I

INFORMATION SHEET

I. Terms and definitions

A. Sill — Lowest member of structure's frame; rests horizontally on foundation and supports floor joists

B. Foundation — Supporting portion of a structure below the first floor construction, including the footings

C. Joist — One of a series of parallel framing members used to support floor and ceiling loads and supported, in turn, by beams or girders

D. Beam or girder — Any large horizontal piece of timber, precast concrete, iron, or other material used to support concentrated loads at particular points along its length

E. Joist header — Framing member into which common joists are fitted forming the box sill; also used to support free ends of joist when framing openings in floor

F. Bridging — Wood or metal pieces fitted in pairs from bottom of one floor joist to top of adjacent joists, and crossed to distribute floor load; solid stock of same size material as joists may be used

G. Span — Distance between structural supports such as walls, columns, piers, beams, or girders

H. Subfloor — Boards or panels laid directly on floor joists and over which finish floor is laid

I. Joist hanger — Metal stirrup secured to face of structural member to support and align ends of joist flush with member

J. Anchor bolt — Bolt embedded in foundation; used to secure sill to foundation

K. Sill sealer — Resilient, waterproof material used under sill as a seal against air, dirt, and insects

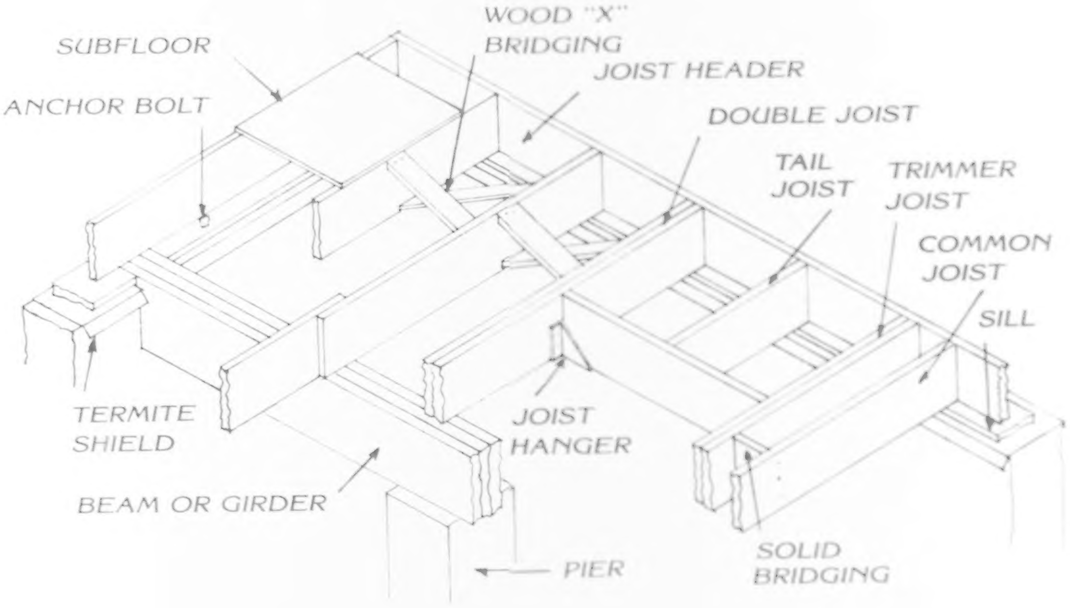
L. Termite shield — Sheet metal placed on foundation wall under sill to prevent passage of termites into structure

M. Crown — High side of curve on edge of framing lumber

INFORMATION SHEET

II. Floor and sill framing and support members (Figure 1)

FIGURE 1


WOOD "X" BRIDGING
SUBFLOOR
JOIST HEADER
ANCHOR BOLT
DOUBLE JOIST
TAIL JOIST
TRIMMER JOIST
COMMON JOIST
SILL
TERMITE SHIELD
JOIST HANGER
BEAM OR GIRDER
PIER
SOLID BRIDGING

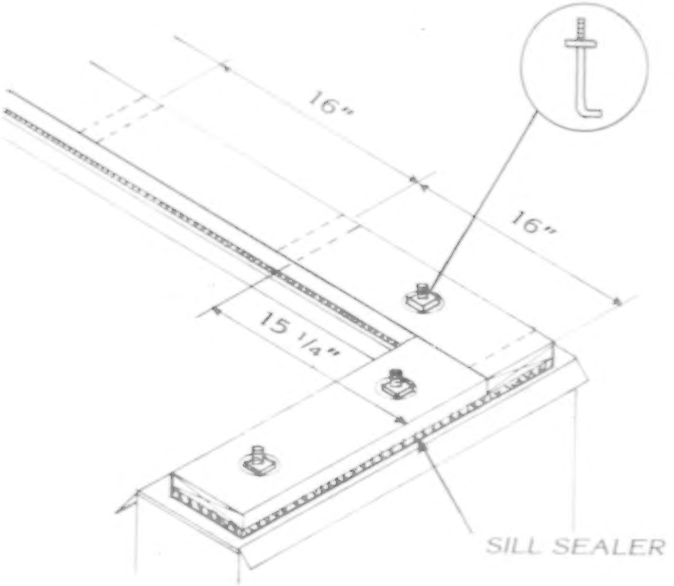
III. Methods used to fasten sills to the foundation (See Figures 2 - 4)

A. Anchor bolts

INFORMATION SHEET

EXAMPLE:

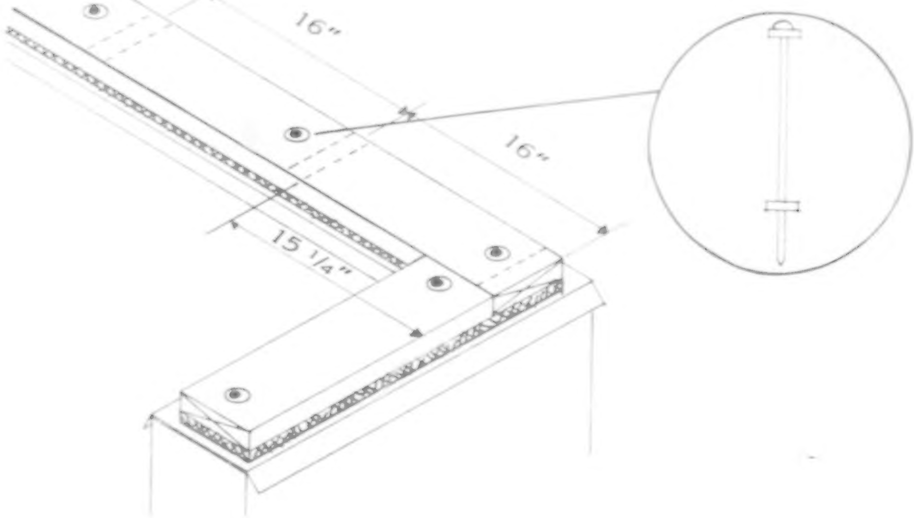
FIGURE 2


16"
16"
15 1/4"
SILL SEALER

B. Powder-actuated pins

EXAMPLE:

FIGURE 3

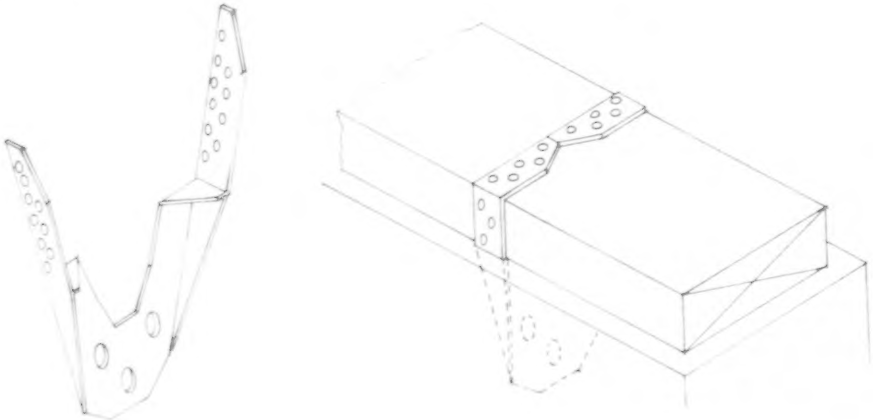


INFORMATION SHEET

C. Metal plates or straps

EXAMPLE:

FIGURE 4



IV. Types of girders

- A. Solid timber
- B. Built-up timber
- C. Steel beam
- D. Precast concrete

(NOTE: A load-bearing wall may take the place of a beam or girder.)

V. Determining proper size girders for safe use

- A. Determine length of span (distance between girder supports)
- B. Determine girder load width

(NOTE: The girder must carry the weight of the floors on each side to the midpoint of the joists that rest upon it.)

INFORMATION SHEET

C. Find total floor load per square foot carried to girder by joists and bearing partitions (See Figure 5)

(NOTE: Total floor load will be the sum of the loads per square foot listed in Table 1, with the exception of roof loads unless braces or partitions are placed under the rafters.)

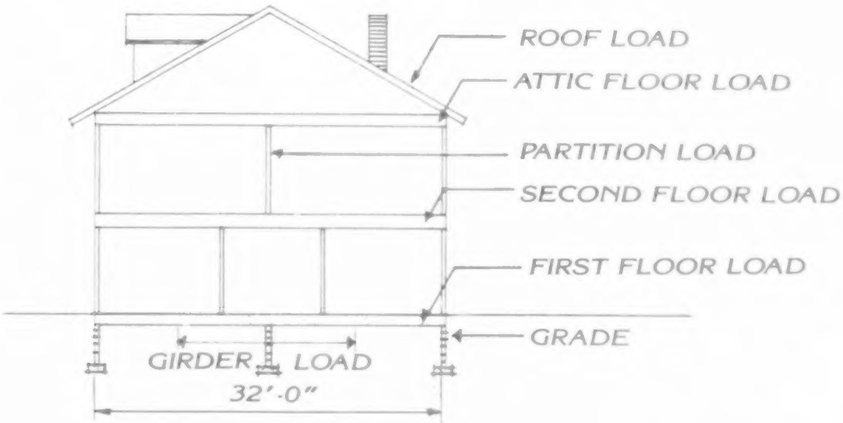
TABLE 1 Girder Load

	Pounds per square foot	
	Live load*	Dead load
Roof	30	10
Attic floor	20	20 (floored) 10 (not floored)
Second floor	40	20
Partitions		20
First floor	40	20 (ceiling plastered) 10 (ceiling not plastered)
Partitions		20

*Usual local requirements

EXAMPLE:

FIGURE 5


ROOF LOAD
ATTIC FLOOR LOAD
PARTITION LOAD
SECOND FLOOR LOAD
FIRST FLOOR LOAD
GRADE
GIRDER LOAD
32'-0"

INFORMATION SHEET

D. Find total load on girder by multiplying girder span times girder load width times total floor load

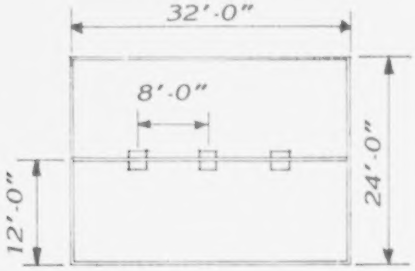
E. Use Table 2 to select proper size girder

(NOTE: Shortening the span is the most economical way to increase the load that a girder will carry.)

TABLE 2 Safe Girder Loads

Nominal Girder Size	Safe load in pounds for spans shown 6 Ft	7 Ft	8 Ft	9 Ft	10 Ft
6 × 8 Solid	8,306	7,118	6,220	5,539	4,583
6 × 8 Built up	7,359	6,306	5,511	4,908	4,062
6 × 10 Solid	11,357	10,804	9,980	8,887	7,997
6 × 10 Built up	10,068	9,576	8,844	7,878	7,086
8 × 8 Solid	11,326	9,706	8,482	7,553	6,250
8 × 8 Built up	9,812	8,408	7,348	6,544	5,416
8 × 10 Solid	15,487	14,732	13,608	12,116	10,902
8 × 10 Built up	13,424	12,968	11,792	10,504	9,448

EXAMPLE: Determine girder requirements for first-floor plan shown using built-up girders if the ceilings are drywall.



1. Span is 8′-0″.
2. Girder load width is 12′-0″ (6′-0″ on each side).
3. Total floor load per square foot from Table 1 is 50 pounds per square foot (40 pounds + 10 pounds).
4. Total load on girder is 8′ × 12′ × 50 pounds per square foot = 4800 pounds.
5. From Table 2 a built-up girder with an 8-foot span must be 6 × 8 to carry a 4800-pound load.

INFORMATION SHEET

VI. Types of joists

   A. Solid wood

   B. Fabricated wood

   C. Steel bar

   D. Steel "C"

   E. Reinforced concrete

VII. Determining proper joist size for ordinary load conditions

   A. Find length of span

   B. Determine live load per square foot

   C. Determine if ceiling below is to be plastered

   D. Use Table 3 to select proper size joist

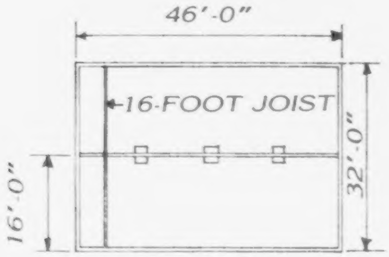
   (NOTE: Table 3 shows maximum safe spans for wood joists under ordinary load conditions.)

TABLE 3 Safe Joist Spans

		Spans for live loads shown			
Nominal Joist Size	30# Spacing	40# Live load	50# Live load	60# Live load	Live load
2×6	12"	14'-10"	13'-2"	12'-0"	11'-1"
	16"	12'-11"	11'-6"	10'-5"	9'-8"
	24"	10'-8"	9'-6"	8'-7"	7'-10"
2×8	12"	19'-7"	17'-5"	15'-10"	14'-8"
	16"	17'-1"	15'-3"	13'-10"	12'-9"
	24"	14'-2"	12'-6"	11'-4"	10'-6"
2×10	12"	24'-6"	21'-10"	19'-11"	18'-5"
	16"	21'-6"	19'-2"	17'-5"	16'-1"
	24"	17'-10"	15'-10"	14'-4"	13'-3"
2×12	12"	29'-4"	26'-3"	24'-0"	22'-2"
	16"	25'-10"	23'-0"	21'-0"	19'-5"
	24"	21'-5"	19'-1"	17'-4"	16'-0"
3×8	12"	24'-3"	21'-8"	19'-10"	18'-4"
	16"	21'-4"	19'-1"	17'-4"	16'-0"
	24"	17'-9"	15'-9"	14'-4"	13'-3"
3×10	12"	30'-2"	27'-1"	34'-10"	23'-0"
	16"	26'-8"	23'-10"	21'-9"	20'-2"
	24"	22'-3"	19'-10"	18'-1"	16'-8"

INFORMATION SHEET

EXAMPLE: The plan below falls into the 40-pound live load category and will be built with joists on 16-inch centers and drywall ceilings.



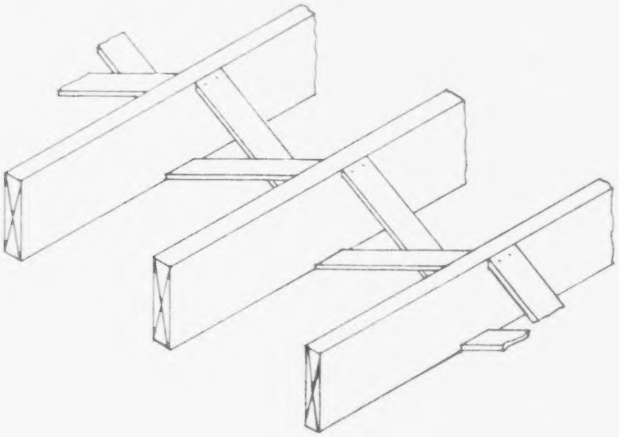
1. Span is 16'.
2. Live load per square foot is 40 pounds.
3. The ceiling will not be plastered.
4. Table 3 shows that a 2 × 10 joist 16 inches o.c. will carry the load up to a span of 19'-2".

   (NOTE: A 2 × 8 joist 16 inches o.c. will carry the required load up to 15'- 3", which is not long enough for the required span.)

VIII. Types of bridging (Figures 6 - 8)

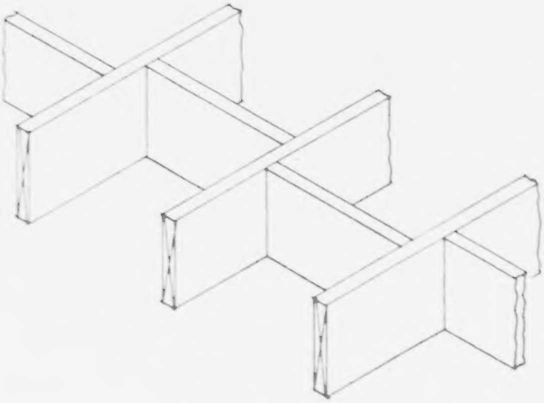
A. Wood "X" bridging (regular bridging)

FIGURE 6



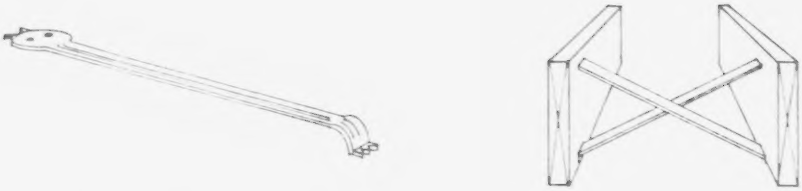
B. Solid wood

FIGURE 7



C. Steel

FIGURE 8



IX. Types of subflooring materials

A. Shiplap lumber

B. Tongue-and-groove lumber

C. Common lumber

D. Plywood

E. Fiberboards

1. Wafer board
2. Strand board
3. Particle board

INFORMATION SHEET

X. Functional designs used to lay subflooring

  A. Subflooring laid diagonally to joists

    1. May be used to lay shiplap, tongue-and-groove, or common lumber

    2. Permits finish floor to be laid in any direction

    3. Provides better than average bracing and stiffness to building

    4. Is preferred in homes of two or more stories

    (NOTE: In two-story homes in which diagonal subflooring is used, the subfloor boards run in opposite diagonal directions on alternate floors to provide better bracing.)

  B. Subflooring laid at right angles to joists

    1. May be used to lay any of the subfloor materials

    (NOTE: Most subflooring today is tongue-and-groove or square-edge plywood. Plywood subfloors provide many advantages over lumber subfloors. They are versatile, inexpensive as compared to lumber subfloors, and require the least amount of labor time [see Table 4]. Plywood subfloors may also be fastened to the joists with a pneumatic stapler or pneumatic nailer, thus making ease of installation another advantage.)

    2. Requires that finish floor run parallel to joists (be laid at right angle to subfloor)

    3. Provides average bracing and stiffness to building

    4. Generally results in less waste than diagonal subfloors

    5. Requires less labor time to install than diagonal subfloors

    EXAMPLE:

TABLE 4 Labor time for installing subfloor

Type of subfloor	Board feet installed per hour
Tongue-and-groove lumber	55
Diagonal lumber	65
Right-angle lumber	75
Plywood	100

INFORMATION SHEET

XI. Purposes of subflooring

- A. Lending bracing strength to building
- B. Providing solid base for finish floor, thus making floor sag and squeaks less likely
- C. Acting as barrier to cold and dampness, thus keeping building warmer and drier in winter
- D. Providing a safe working surface for constructing the building

XII. Fasteners used in floor framing and their uses

- A. 16d box nails — Used to attach header to joist, install solid bridging, and to construct beams and girders
- B. Special nails — Furnished to attach joist hangers
- C. 8d box nails — Used to install wood "X" bridging and subfloor
- D. Pneumatic, ring shank, and screw nails — Used to apply subfloor
- E. Construction glue or adhesive — Used to install subfloor, sheathing, wall paneling, and siding

  (NOTE: Glued subfloors are more stable than nailed subfloors. They are less noisy and are squeak free.)

XIII. Estimating materials

- A. Check building specificiations for kinds and dimensions of materials
- B. Use plans to check dimensions
  - 1. Sill sealer — Lineal feet
  - 2. Termite shield — Lineal feet
  - 3. Sill — Size, lineal feet
  - 4. Beams or girders — Size, lineal feet
  - 5. Joists — Number, size, length
    - a. Determine length needed and round to next highest even foot

INFORMATION SHEET

b. Determine number of joists needed

1) For 16 inches on center, multiply length of building by $^3/_4$, and add one joist for end and one joist for each partition that runs parallel to joists

2) For 24 inches on center, multiply length of building by $^1/_2$, and add one joist for end and one joist for each partition that runs parallel to joists

6. Joist headers — Size, lineal feet

(NOTE: Allow enough for twice the length of the building and all openings.)

7. Bridging

(NOTE: One row of bridging is required in spans over 8 feet and less than 16 feet in length. Two rows of bridging are required in spans over 16 feet.)

a. Wood "X" bridging — Lineal feet

(NOTE: Bridging is usually cut from 1×4 rough lumber.)

1) Determine number of rows of bridging needed

2) Determine length of each row of bridging

3) Multiply total lineal footage of bridging rows by appropriate factor from Table 5 to get total lineal feet of bridging needed

TABLE 5

Joist size (nominal)	Spacing (inches) on center)	Lineal feet of material (per foot of bridging row)
2×6 to 2×10	16	2
2×12	16	$2^1/_4$
2×14	16	$2^1/_2$

(NOTE: If the joists are 24 inches on center, the total lineal footage of bridging rows is equal to the number of pieces of bridging material needed.)

INFORMATION SHEET

b. Steel bridging — Number of each for joists 16 inches on center

1) Determine number of rows of bridging needed

2) Determine length of each row of bridging

3) Multiply total lineal footage of bridging rows by $3/4$ to find the number of spaces between joists 16 inches on center

4) Multiply above product by 2 to determine total number of pieces needed

(NOTE: If the joists are 24 inches on center, the total lineal footage of bridging rows is equal to the number of pieces of bridging material needed.)

c. Solid lumber bridging — Lineal feet

1) Determine number of rows of bridging needed

2) Determine length of each row of bridging

3) Multiply number of rows by length of each row to determine total lineal feet needed

8. a. Lumber — Board feet

1) Calculate area of entire floor to be covered, ignoring small openings in floor

2) Calculate amount of material allowed for waste, using Table 6, and add to total area

TABLE 6

Material	Allowance when laid at right angles to joists, %	Allowance when laid diagonally, %
1×6 tongue-and-groove	20	25
1×8 tongue-and-groove	15	20
1×6 shiplap	20	25
1×8 shiplap	15	20
1×6 square edge	12	17
1×8 square edge	10	15

(NOTE: Rule of thumb: for 1×6 lumber, add to the total area $1/6$ for waste; for 1×8 lumber, add $1/8$ for waste.)

INFORMATION SHEET

b. Plywood — Square feet or number of pieces

1) Calculate area of entire floor
2) Divide square feet of floor area by total square feet in one sheet of plywood (32)
3) Round any fractional sheets to next whole sheet

FLOOR AND SILL FRAMING
UNIT I

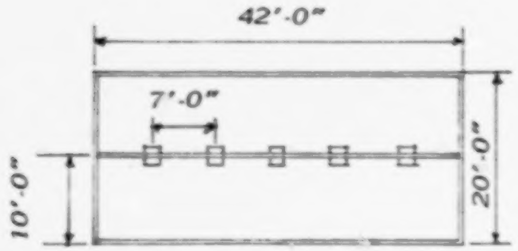
ASSIGNMENT SHEET #1 — DETERMINE PROPER GIRDER SIZE FOR SAFE USE

NAME ______________________________ SCORE ______________

In structures with perimeter foundations, much of the structural load must be carried by girders. If the girders are unable to carry the load, damage to the house is likely and collapse is possible. Thus, a carpenter must be sure that girders used meet the requirements for safe use.

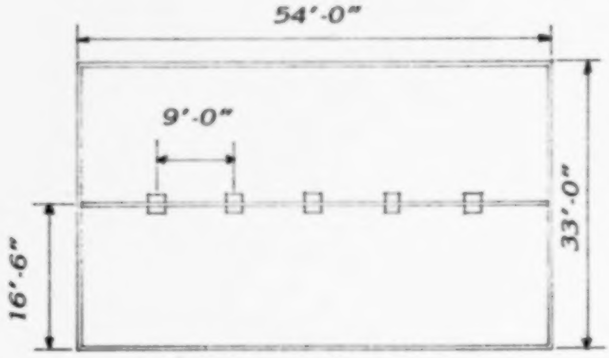
Use the information and tables in Section V of the information sheet to compute the proper girder size for each situation described.

A. In the plan below, solid timber girders will be used and the ceilings will be plastered.



Girder size ______________

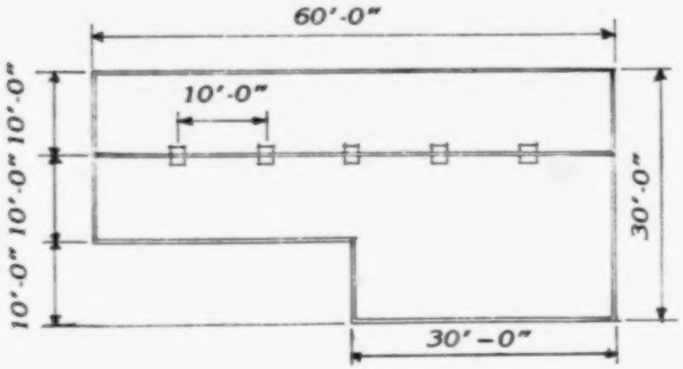
B. Built-up girders and Drywall ceilings are to be used in the plan below.



Girder size ______________

ASSIGNMENT SHEET #1

C. The plan below will be constructed using built-up girders and drywall ceilings.


60'-0"
10'-0"
10'-0" 10'-0" 10'-0"
30'-0"
30'-0"

Girder size ______________

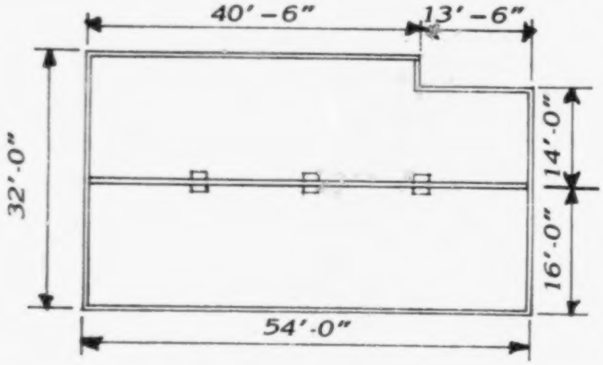
FLOOR AND SILL FRAMING
UNIT I

ASSIGNMENT SHEET #2 — DETERMINE PROPER JOIST SIZE FOR ORDINARY LOAD CONDITIONS

NAME ______________________________ SCORE ______________

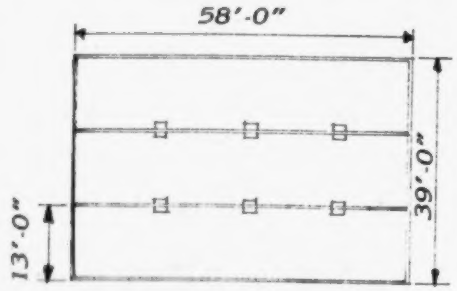
Joists are used to distribute the weight of the structure over the support provided by the foundation and girders. Each joist is required to carry a certain portion of the total load of the structure. For the building to remain standing without damage, each joist must be able to carry its share of the load. To ensure that this critical function is met, the carpenter must be able to determine the correct joist size for the structural load. Using the information in Section VII of the information sheet, determine the proper joist size for the situations given.

A. This plan is designed so that the house has a 50-pound live load with its plaster ceiling. What size joist is required if the joists are spaced 24 inches O.C.?



Joist size ____________

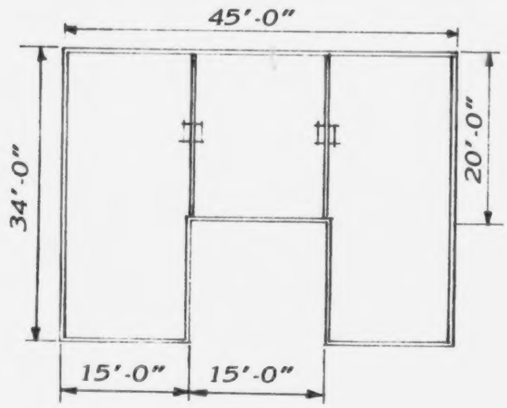
B. In the plan below, a drywall ceiling will be used. The house is in the 40-pound live load category with joists 16 inches O.C. What size joist is required?



Joist size ____________

ASSIGNMENT SHEET #2

C. This plan calls for a drywall ceiling and joists 24 inches O.C. The joists will carry a live load of 40 pounds per square foot. What size joist is required?



Joist size ______________

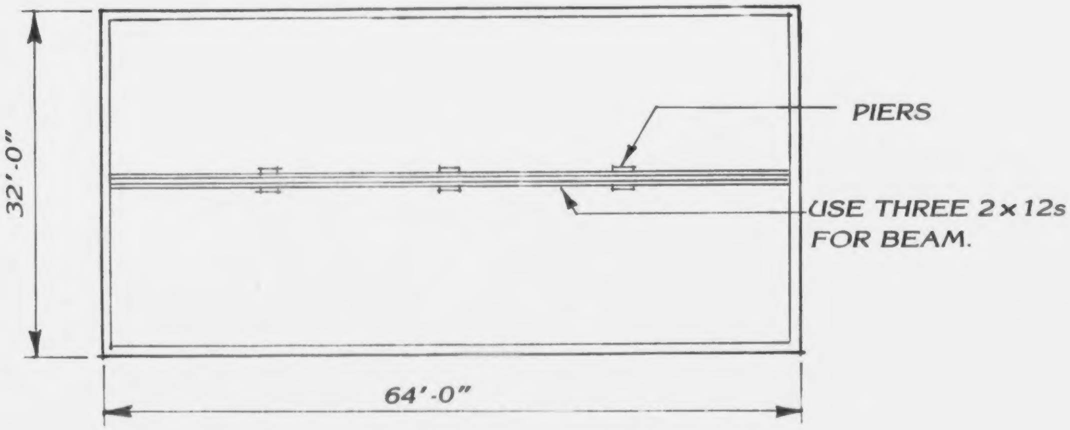
FLOOR AND SILL FRAMING
UNIT I

ASSIGNMENT SHEET #3 — ESTIMATE AMOUNT OF MATERIAL NEEDED TO FRAME A FLOOR AND SILL AND TO LAY A SUBFLOOR

NAME ______________________________ SCORE ____________

Because of the importance of the floor in carrying the weight of the structure, it is important that a carpenter be able to correctly determine the materials required. The carpenter must be able to recognize special needs such as those for openings, cantilevers, and partition support that affect material requirements. Once the needs are determined, the carpenter must be able to estimate the quantities of materials needed in order to continue the project without delays or added expense from too much material.

Using the information sheet, calculate the floor and sill framing materials needed for the building depicted below. Set joists on sixteen-inch centers. The plans call for solid lumber bridging and plywood subflooring.



________ A. Sill sealer

________ B. Termite shield flashing

________ C. Sill

________ D. Beams or girders

________ E. Joists

________ F. Joist headers

________ G. Bridging (solid lumber)

________ H. Subflooring, plywood (number of 4×8 pieces)

FLOOR AND SILL FRAMING
UNIT I

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. 6×8

B. 6×10

C. 6×10

Assignment Sheet #2

A. 2×12

B. 2×8

C. 2×10

Assignment Sheet #3

A. 192 lineal feet

B. 192 lineal feet

C. 192 lineal feet

D. 192 lineal feet of 2×12s or one beam 6×12×64′

E. 49 joists or 98—2×12s×16′

F. 128 lineal feet of 2×12s

G. 128 lineal feet of 2×12s

H. 64 pieces

FLOOR AND SILL FRAMING
UNIT I

JOB SHEET #1 — BUILD A BOX SILL, INSTALL FLOOR JOIST, AND FRAME AN OPENING

I. Tools and materials

A. Tools

1. Power handsaw and extension cord
2. Electric hand drill
3. Flat bit, 5/8″
4. Tin snips
5. Claw hammer
6. Framing square
7. Level
8. One-hundred-foot tape
9. Folding rule or steel tape
10. Saber or reciprocating saw
11. Adjustable wrench, 12″

B. Materials

1. Sill sealer
2. Flashing for termite shield
3. Beam material
4. 2×6s for sills
5. 2×10s for joists and headers
6. 1×4s or solid lumber for bridging
7. 8d box nails for bridging
8. 16d.box nails for joists and headers
9. Grout
10. Shim materials

JOB SHEET #1

II. Procedure

A. Check foundation for square and level

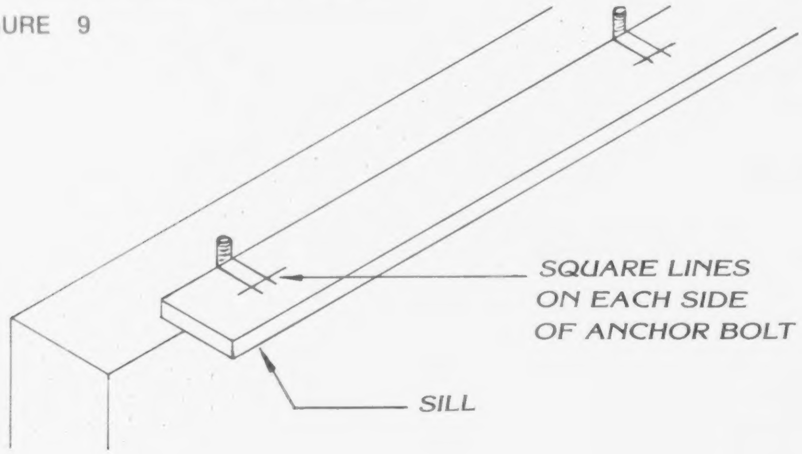
B. If foundation is not level, use grout to level it

C. Strike lines on foundation

D. Lay 2×6 sill material on top of foundation as shown in Figure 9; mark location of sill anchors and cutouts for girders and other construction features

E. Locate hole centers on sill (Figure 9)

FIGURE 9

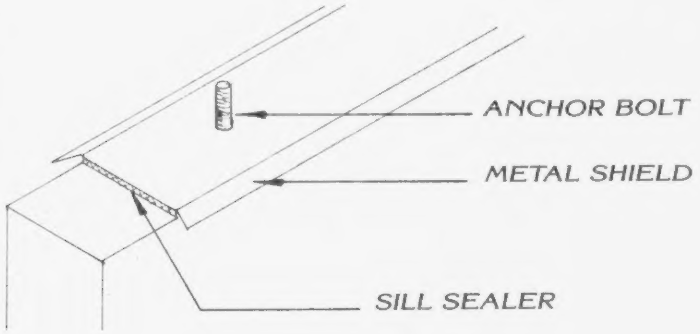

SQUARE LINES ON EACH SIDE OF ANCHOR BOLT
SILL

F. Drill 5/8-inch holes through sill at anchor bolt locations

G. Cut sill sealer to length and lay on top of foundation

H. Cut flashing for termite shield to length, shape as shown in Figure 10, cut holes for anchor bolts, and place shield on top of sill sealer

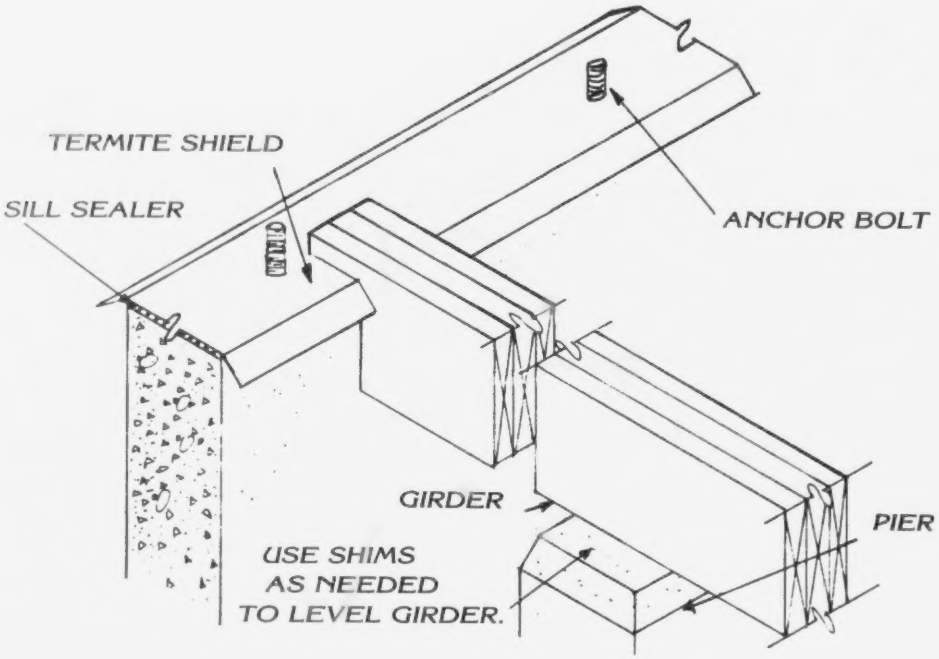
FIGURE 10


ANCHOR BOLT
METAL SHIELD
SILL SEALER

JOB SHEET #1

I. Build beam or girder, if one is necessary, and place it in position on piers, using shims as necessary to level it (Figure 11)

FIGURE 11

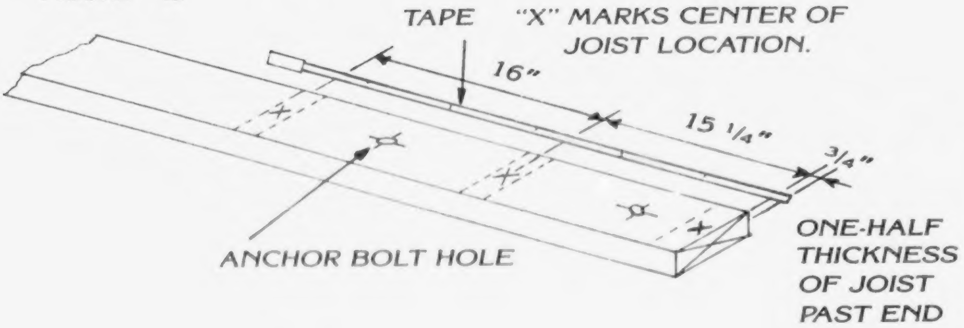

TERMITE SHIELD
SILL SEALER
ANCHOR BOLT
GIRDER
PIER
USE SHIMS AS NEEDED TO LEVEL GIRDER.

J. Lay off sill for floor joists on 16-inch centers

1. Start at one end using 100-foot tape marked for 16-inch centers
2. Hold end of tape half the thickness of a 2×10 past end of sill; mark sill every 16 inches for full length, repeating the operation for other end of joist at girder or opposite sill (See Figure 12)

JOB SHEET #1

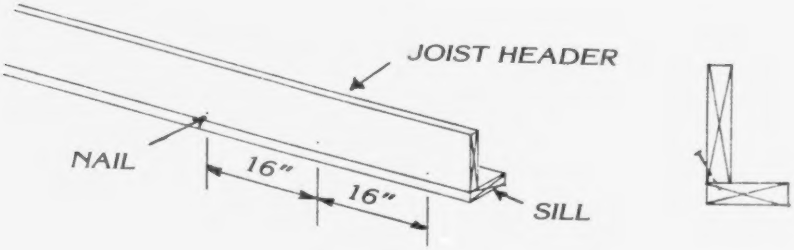
FIGURE 12


TAPE
"X" MARKS CENTER OF JOIST LOCATION.
16"
15 1/4"
3/4"
ANCHOR BOLT HOLE
ONE-HALF THICKNESS OF JOIST PAST END

3. Mark and cut sill to allow for girders and other structural features

K. Cut joist headers to length and toenail to sill with 16d box nails to form box sill (Figure 13)

FIGURE 13


JOIST HEADER
NAIL
16"
16"
SILL

L. Place sill and box sills on top of termite shield all around perimeter of the structure

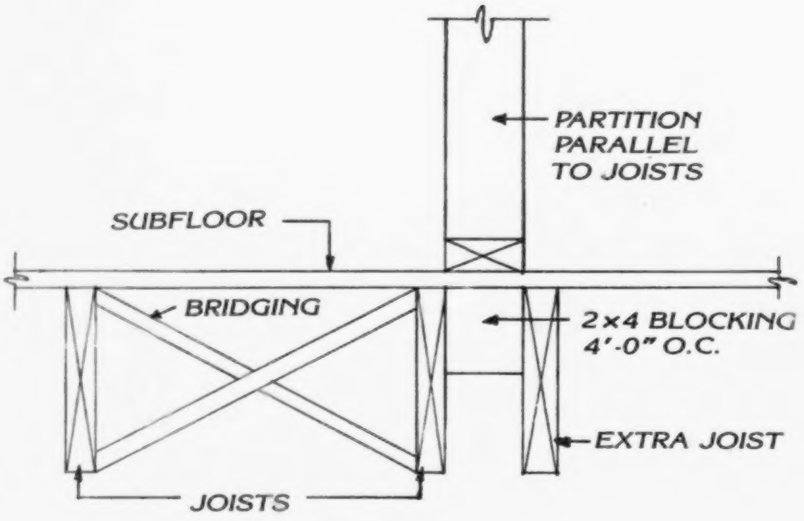
M. Attach nut to anchor bolt and tighten

N. Distribute floor joists at every spot marked on sill; sight along edge of each joist, and lay joist on sill with crown up

O. Add an extra joist on opposite side of partition wall locations from joist nearest to partition wall that runs parallel to joists (See Figure 14; see also Figure 15)

JOB SHEET #1

FIGURE 14

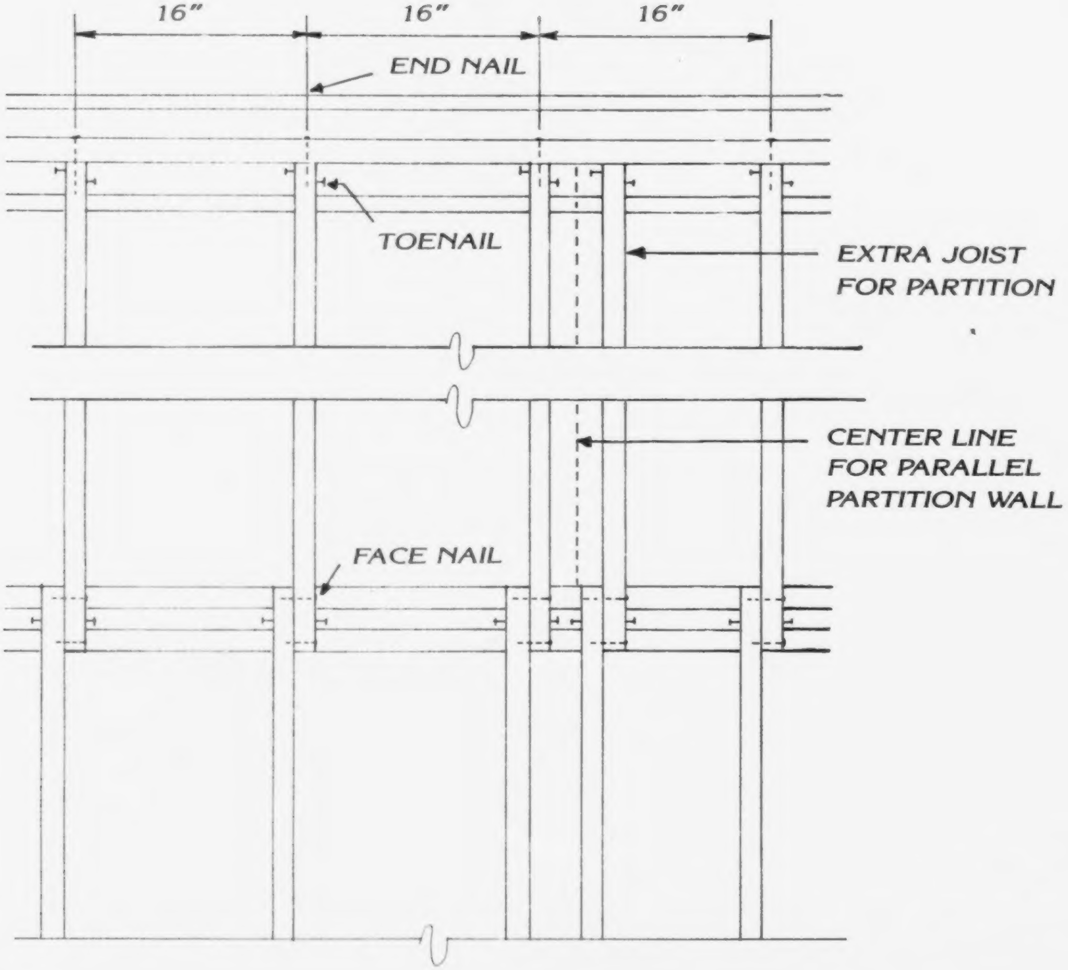

PARTITION PARALLEL TO JOISTS
SUBFLOOR
BRIDGING
2×4 BLOCKING 4'-0" O.C.
EXTRA JOIST
JOISTS

P. Place joist centers on positions marked on sill; nail in place (See Figure 15)

1. Nail to header with three 16d box nails
2. Toenail to sill with two 16d box nails
3. Lap joists over beam and toenail to beam
4. Nail joists together

JOB SHEET #1

FIGURE 15

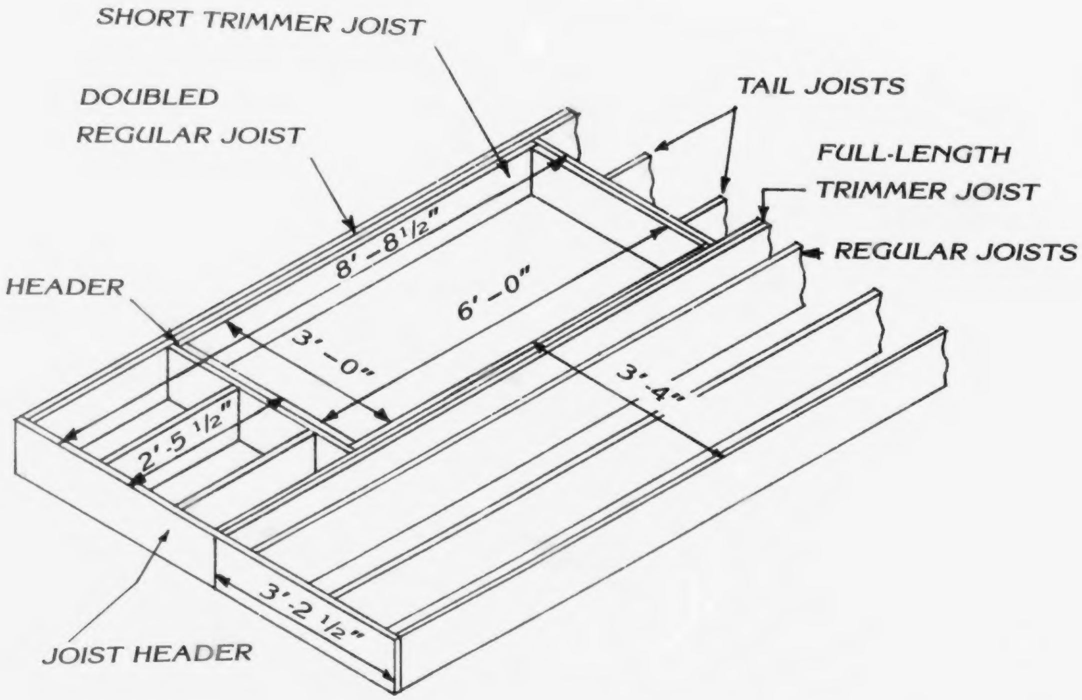

16"
16"
16"
END NAIL
TOENAIL
EXTRA JOIST
FOR PARTITION
CENTER LINE
FOR PARALLEL
PARTITION WALL
FACE NAIL

Q. Frame openings in floor

EXAMPLE: Frame 3'-0"×6'-0" opening 3'-4" from side of frame and 2'-5½" from end of frame (See Figure 16)

JOB SHEET #1

FIGURE 16


SHORT TRIMMER JOIST
DOUBLED
REGULAR JOIST
TAIL JOISTS
FULL-LENGTH
TRIMMER JOIST
REGULAR JOISTS
HEADER
8′-8 1/2″
6′-0″
3′-0″
3′-4″
2′-5 1/2″
3′-2 1/2″
JOIST HEADER

1. On side opposite proposed opening, measure in 3′-2½″ along header joist; mark
2. Install full length trimmer joist at this point
3. Cut off fourth and fifth regular joists at 2′-2 ½″ and at 8′-8 ½″ from header joist
4. Cut two header joists to fit snugly between full length trimmer and doubled regular joist
5. Nail headers to tail joists at both ends; nail through trimmer joists and regular joist into headers
6. Cut two short joists 6′-3″ long and nail in place against regular joist and trimmer joist as shown in Figure 16
7. Cut a trimmer joist to full length and nail to first full trimmer, making it a double joist

JOB SHEET #1

8. Cut a regular joist to full length and nail to regular joist on opposite side, making it a double joist

R. Clean up work area and put away tools and materials

FLOOR AND SILL FRAMING
UNIT I

JOB SHEET #2 — INSTALL BRIDGING

I. Tools and materials

   A. Tools

      1. Table saw or radial arm saw
      2. Framing square
      3. Claw hammer
      4. Folding rule or steel tape

   B. Materials for bridging

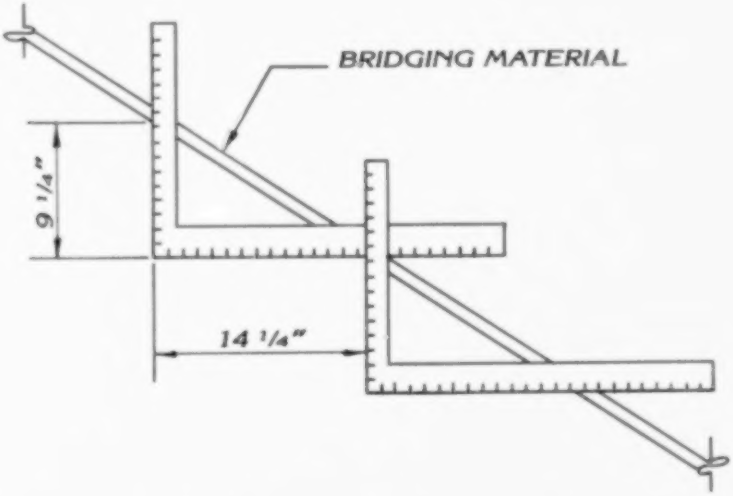
      1. 1×4 lumber "X" bridging
      2. Lumber the same size as the joists for solid bridging
      3. Steel bridging and instructions
      4. 8d box nails

II. Procedure

   A. Wood "X" bridging

      1. Figure number of pieces of wood "X" bridging needed
      2. Use framing square, and lay out bridging as illustrated in Figure 17

FIGURE 17



(NOTE: Due to variations in lumber thicknesses, the length may have to be adjusted for actual installation.)

JOB SHEET #2

3. Cut bridging to length

4. Install bridging, nailing only top ends at this time (Figures 18 and 19)

FIGURE 18

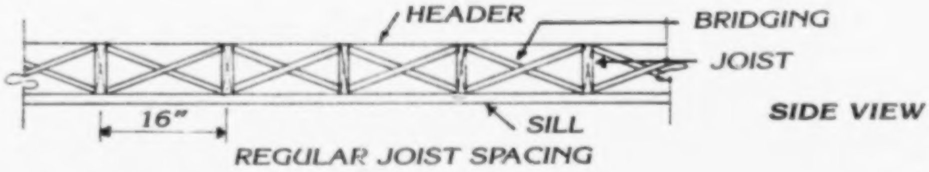
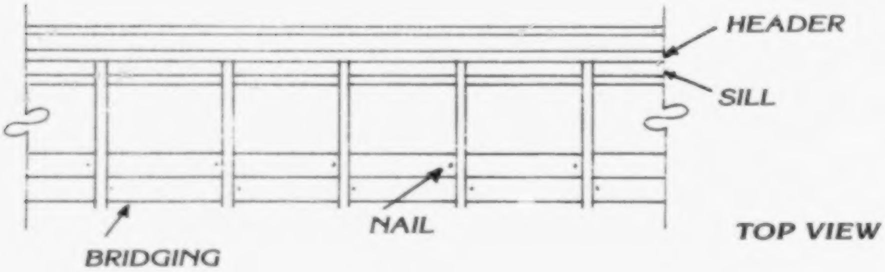

HEADER
BRIDGING
JOIST
SIDE VIEW
16"
SILL
REGULAR JOIST SPACING

FIGURE 19


HEADER
SILL
TOP VIEW
NAIL
BRIDGING

B. Solid lumber bridging

1. Figure number of pieces of solid lumber bridging needed

2. Determine length of bridging

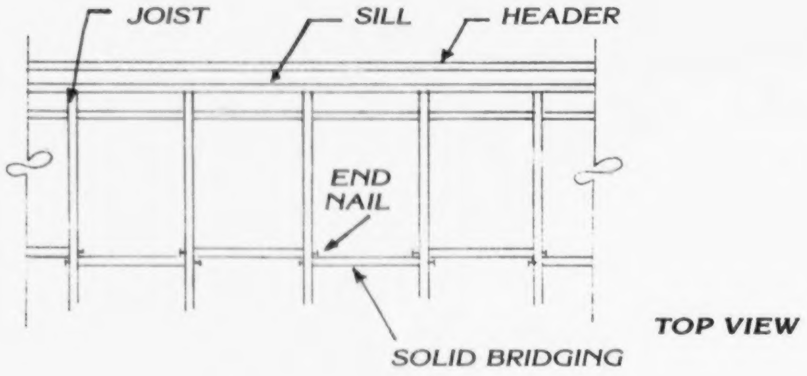
3. Cut bridging 14½ inches long

   (NOTE: Due to variations in lumber thicknesses, the length may have to be adjusted for actual installation.)

JOB SHEET #2

4. Install bridging in a staggered pattern to facilitate nailing (Figure 20)

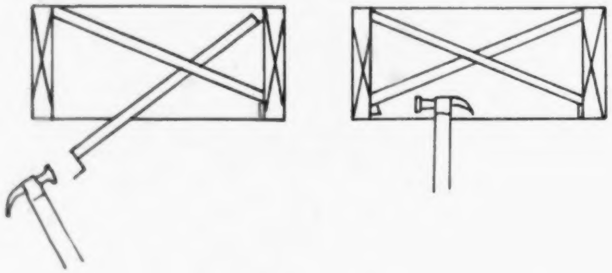
FIGURE 20


JOIST
SILL
HEADER
END NAIL
TOP VIEW
SOLID BRIDGING

C. Steel "X" bridging

1. Figure number of pieces needed
2. Install bridging, following manufacturer's instructions (Figure 21)

FIGURE 21



D. Clean up work area and put away tools and materials

FLOOR AND SILL FRAMING
UNIT I

JOB SHEET #3 — LAY DIAGONAL AND RIGHT-ANGLE SUBFLOORS

I. Tools and materials

A. Tools

1. Power handsaw and extension cord
2. Claw hammer
3. Framing square
4. Chalk line
5. Sliding T-bevel
6. Folding rule or steel tape
7. Saber or reciprocating saw to cut holes for pipes if necessary
8. Pencil

B. Materials

1. For diagonal subfloor
   a. Enough 1×6 or 1×8 lumber to cover floor area

      (NOTE: Choose boards that are thoroughly dry. The use of green boards frequently results in squeaks and cracks.)

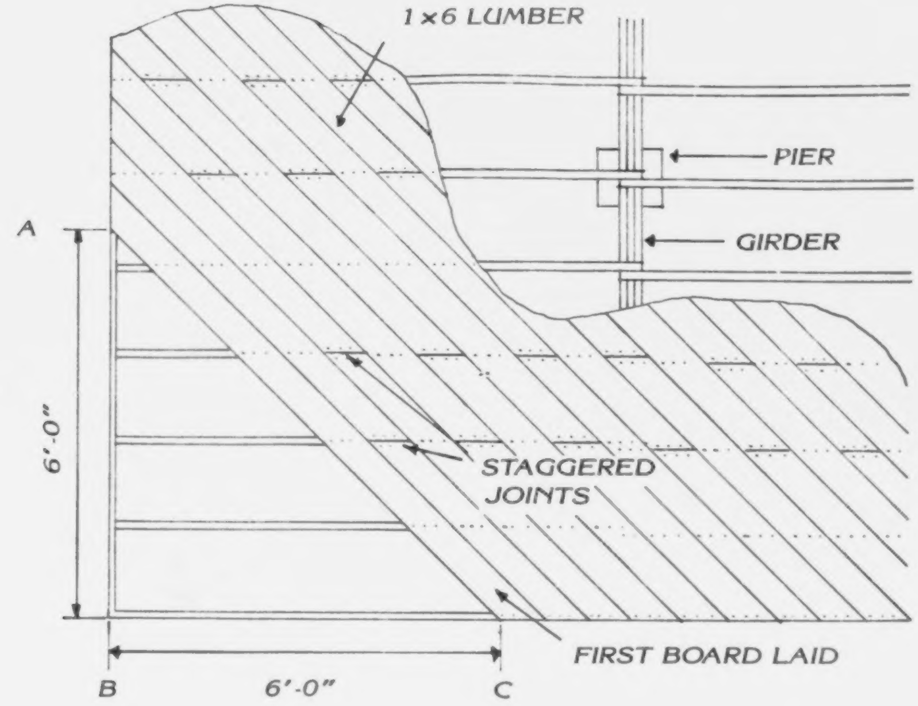
   b. 8d box nails
2. For right-angle subfloor
   a. Enough 1×6 or 1×8 lumber to cover floor area
   b. Enough 5/8-inch plywood to cover floor area
   c. 8d box nails

II. Procedure for installing diagonal subfloor

A. Begin at corner of building and measure equal distances (6 feet) along header joist and along first joist (Points A and C in Figure 22)

JOB SHEET #3

FIGURE 22



(NOTE: For simplification, bridging and other details have been omitted from the drawing.)

B. Snap chalk line along top of joists between these two points to form a 45-degree angle

C. Lay a relatively long board along this line

(NOTE: Generally, the shortest pieces of board should be long enough to span three joists — that is, start at one joist, span another, and be fastened to the third. Of course, shorter pieces will have to be used in the corners.)

D. Use sliding T-bevel to mark board where it will rest on center of joist

E. Cut board to fit

F. Nail board to joist, using three 8d nails per joist, not more than 3/4 inch from edge

(NOTE: Boards must be nailed solidly at each bearing point. Improper or inadequate nailing of the subfloor almost invariably results in squeaky floors. As a rule of thumb, use three 8d box nails per joist for 1×6 and 1×8 lumber.)

JOB SHEET #3

G. Measure other pieces of subfloor boards to make up first diagonal strip, allowing ends of boards to run wild over joist header

H. Cut and nail ends of these pieces so that they butt together at top center of joist, forming a joint

I. Repeat this process to lay remainder of subflooring, spacing boards about 1/4 inch apart and staggering all joints as shown in Figure 22

(NOTE: Many carpenters use an 8d nail to space between the edges of the subfloor boards. This spacing allows for drainage and buckling that can occur if the subfloor gets wet during construction. Tongue-and-groove subflooring should have holes drilled at intervals to allow rainwater to run off.)

J. Trim ends that were allowed to run wild over joist header

K. Clean up work area and put away tools and materials

III. Procedure for installing right-angle subfloors

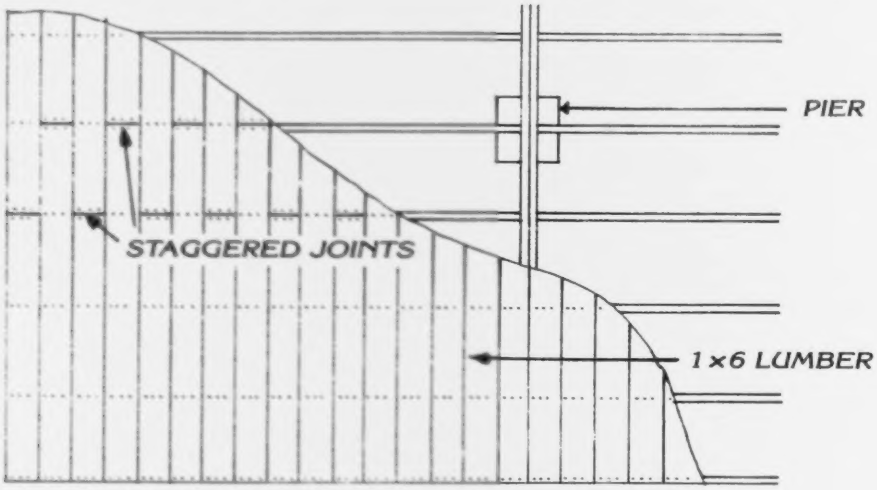
A. Lumber subfloor

(NOTE: When on an actual job, always check the plans to determine the direction the finish floor is to be laid in relation to the direction of the floor joists. If the finish floor is to be laid parallel to the joists, a straight or right-angle lumber subfloor may be laid.)

1. Start at corner from which joist was laid off and lay first board at right angle to joists
2. Mark board where it will rest on center of joist; cut to fit
3. Nail board to joist, using three 8d box nails per joist, not more than 3/4 inch from edge
4. Measure, cut, and nail other pieces of subfloor boards to make up first right-angle strip
5. Cut and nail ends of these pieces so that they butt together at center of joist, forming a joint
6. Repeat this process to lay remainder of subflooring, spacing boards about 1/4 inch apart and staggering all joints as shown in Figure 23

JOB SHEET #3

FIGURE 23



7. Clean up work area and put away tools and materials

B. Plywood subfloor

(NOTE: Check local building requirements for nail spacing.)

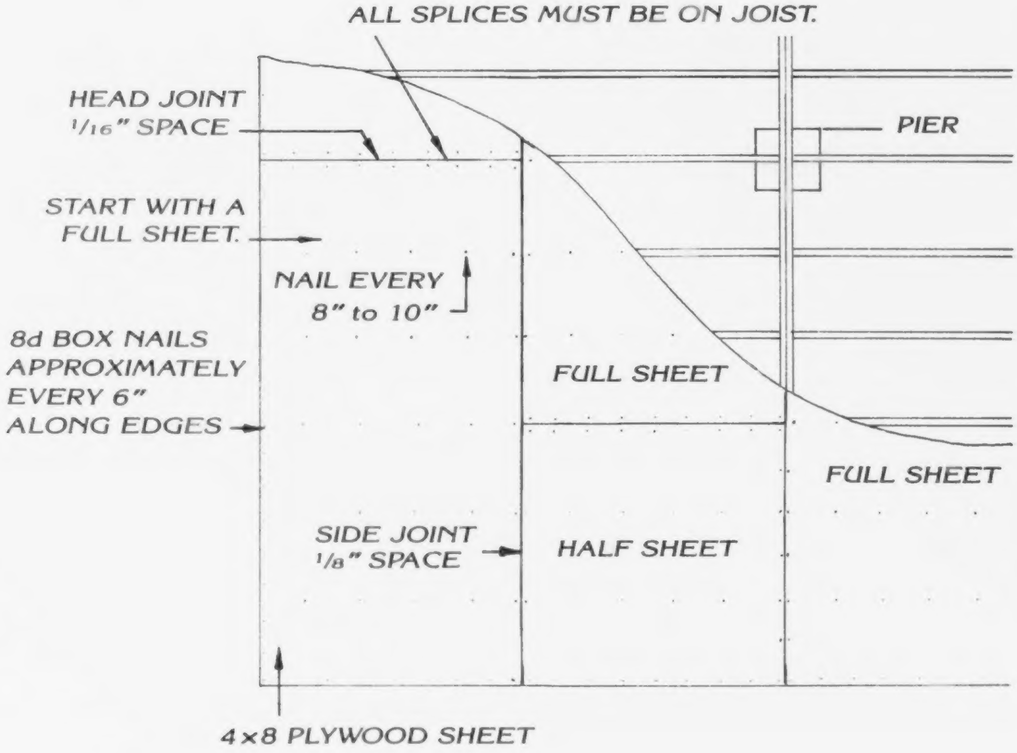
1. Begin by placing a full sheet of plywood even with one of the outside corners of the joist framing, making sure that the grain of the plywood runs at right angles to the joists (See Figure 24)
2. Make sure that all edges rest on centers of joists
3. Drive just enough nails to hold the plywood in place
4. Place next full sheet in position at end of first sheet; be sure that joint is centered over joist, and leave about 1/16-inch space between the panels at the head joint
5. Begin the second row of sheets next to the first panel laid
    a. Cut a panel in half
    b. Lay end of half panel flush with outside of building, leaving about 1/8 inch of space at side joint
    c. Nail half panel to joists

    (NOTE: If the joists are running at right angles to the grain direction, measure and cut the panel so that the joint will be on the fourth joist.)

JOB SHEET #3

6. Continue to lay and nail panels in the second row
7. Start the third row of panels with a full sheet; this will stagger the joints and provide the strongest floor

FIGURE 24


ALL SPLICES MUST BE ON JOIST.
HEAD JOINT 1/16" SPACE
PIER
START WITH A FULL SHEET.
NAIL EVERY 8" to 10"
8d BOX NAILS APPROXIMATELY EVERY 6" ALONG EDGES
FULL SHEET
FULL SHEET
SIDE JOINT 1/8" SPACE
HALF SHEET
4×8 PLYWOOD SHEET

8. Continue to lay the subfloor, driving just enough nails in each panel to hold it in position, until all panels are laid
9. Nail all panels as per local building codes
10. Clean up work area and put away tools and materials

FLOOR AND SILL FRAMING
UNIT I

JOB SHEET #4 — INSTALL JOISTS FOR A CANTILEVER FLOOR

I. Tools and materials

A. Tools

1. Power handsaw and extension cord
2. Claw hammer
3. Framing square
4. Level
5. Folding rule or steel tape
6. One-hundred-foot tape

B. Materials

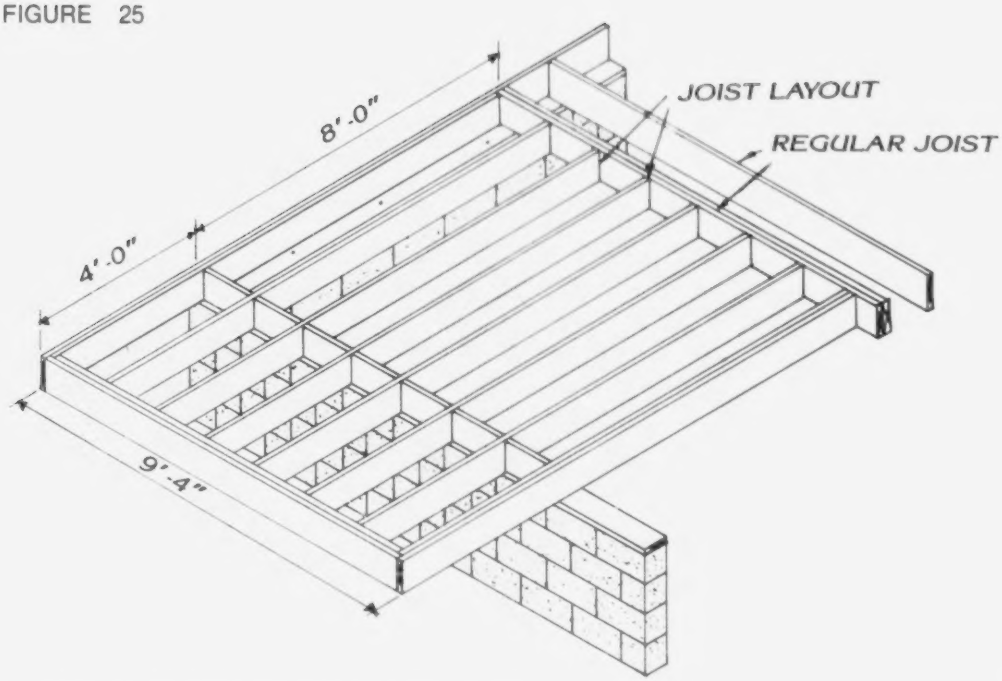
1. 2×10s for joists and headers
2. 8d box nails
3. 16d box nails

II. Procedure for parallel floor joists

(NOTE: The framing procedure for parallel floor joists is comparatively simple. All you do is use longer floor joists and extend them out the length of the projection, keeping in mind that the joist should extend inward a distance equal to at least twice the overhang. See Figure 25.)

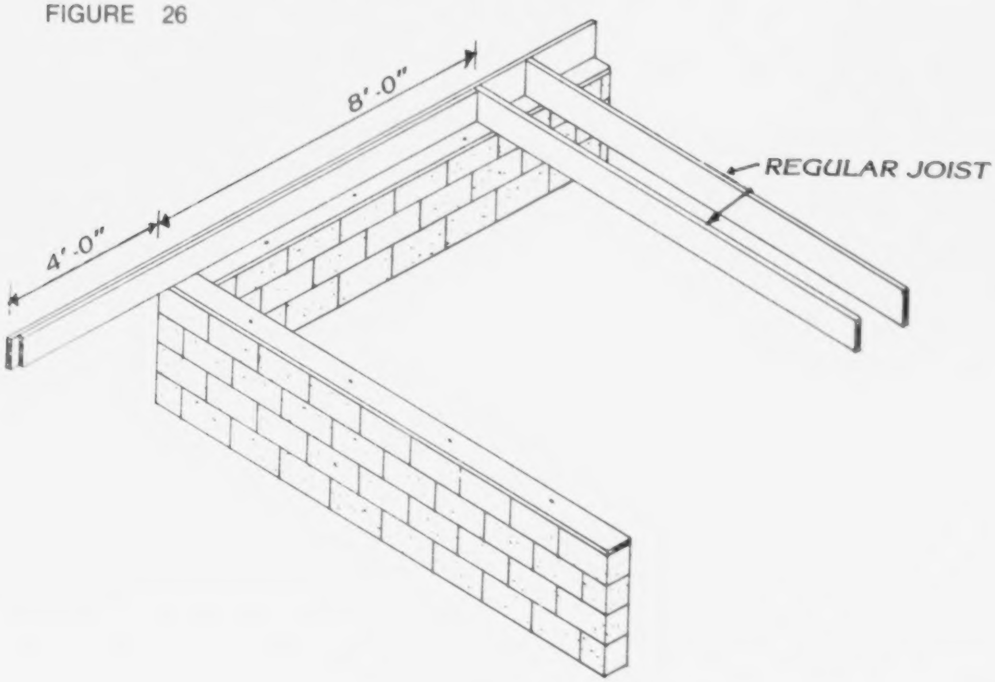
JOB SHEET #4

FIGURE 25


JOIST LAYOUT
REGULAR JOIST
8'-0"
4'-0"
9'-4"

A. Begin by doubling the first joist (Figure 26)

FIGURE 26


8'-0"
4'-0"
REGULAR JOIST

JOB SHEET #4

B. Measure, cut, and nail in double joist on opposite end

(NOTE: It may be necessary to notch top of all cantilever joists so that deck will be slightly lower than the door sill.)

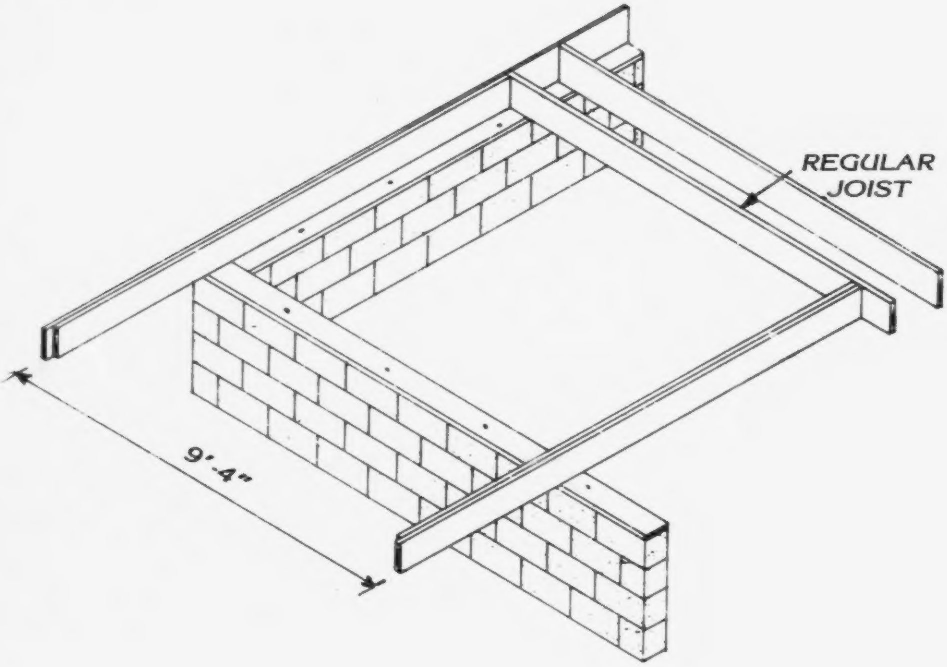
1. Measure across header and mark end joist location at opposite end; also mark same location on plate

2. Measure and cut two joists for double joist

   (NOTE: Inside joist will be 1½ inches shorter to receive header. Nail these together before installing.)

3. Nail double joist in place at marked location (Figure 27)

FIGURE 27



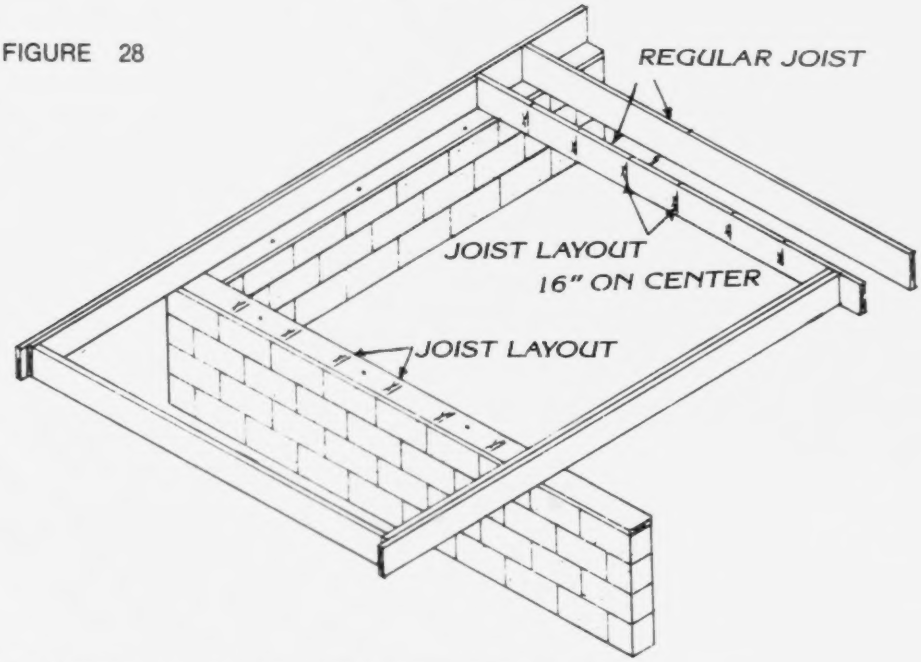
C. Lay out joists 16 inches on center at both sill and header

D. Measure and cut header to fit between the two short members in the double joist

E. Nail in header (See Figure 28)

JOB SHEET #4

FIGURE 28

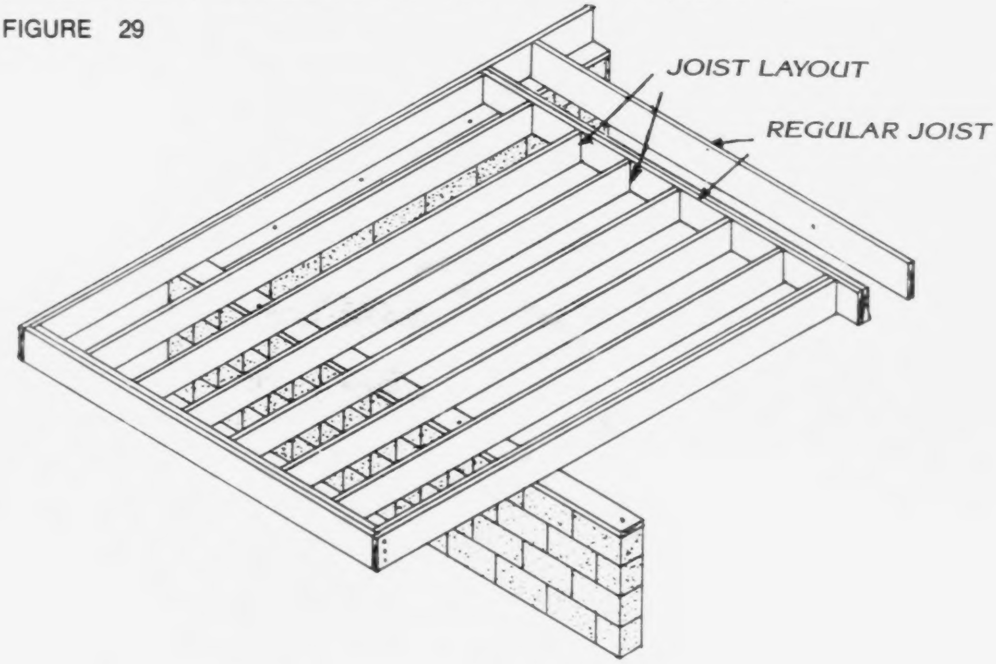

REGULAR JOIST
JOIST LAYOUT
16" ON CENTER
JOIST LAYOUT

F. Measure, cut, and then nail in remainder of joists

(NOTE: Joists, spacing, and size depend on size of deck and provide for carrying the live loads.)

G. Measure, cut, and nail in double header on both ends (Figure 29)

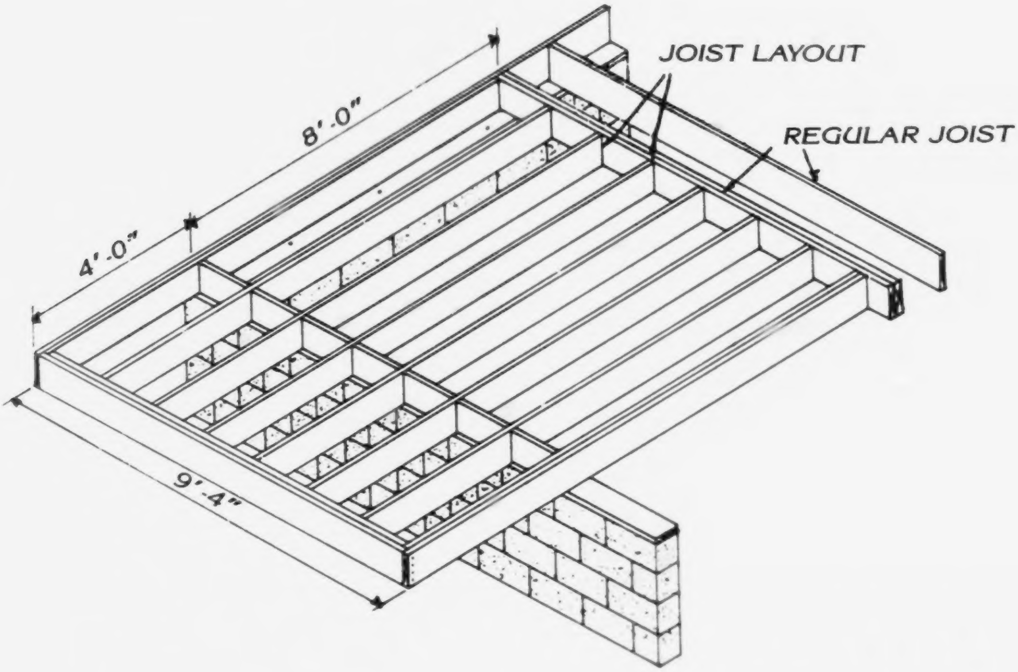
FIGURE 29


JOIST LAYOUT
REGULAR JOIST

JOB SHEET #4

H. Use solid blocking to block between joists at building line (Figure 30)

FIGURE 30


JOIST LAYOUT
REGULAR JOIST
8'-0"
4'-0"
9'-4"

I. Clean up work area and put away tools and materials

FLOOR AND SILL FRAMING
UNIT I

TEST

NAME ____________________ SCORE ____________

1. Match to their correct definitions terms associated with floor and sill framing. Write the correct numbers in the blanks.

______a. Sheet metal placed on foundation wall under sill to prevent passage of termites into structure

______b. One of a series of parallel framing members used to support floor and ceiling loads and supported, in turn, by beams or girders

______c. Distance between structural supports such as walls, columns, piers, beams, or girders

______d. Framing member into which common joists are fitted forming the box sill; also used to support free ends of joist when framing openings in floor

______e. Bolt embedded in foundation; used to secure sill to foundation

______f. High side of curve on edge of framing lumber

______g. Lowest member of structure's frame; rests horizontally on foundation and supports floor joists

______h. Supporting portion of a structure below the first floor construction, including the footings

______i. Wood or metal pieces fitted in pairs from bottom of one floor joist to top of adjacent joists, and crossed to distribute floor load; solid stock of same size material as joists may be used

______j. Boards or panels laid directly on floor joists and over which finish floor is laid

______k. Any large horizontal piece of timber, precast concrete, iron, or other material used to support concentrated loads at particular points along its length

______l. Resilient, waterproof material used under sill as a seal against air, dirt, and insects

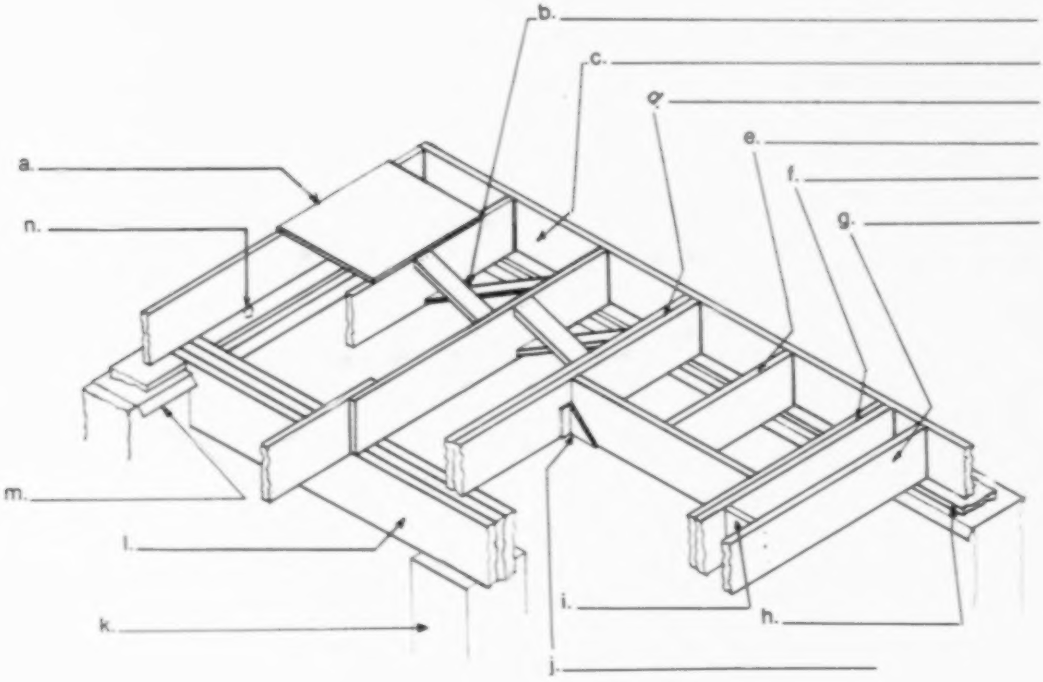
______m. Metal stirrup secured to face of structural member to support and align ends of joist flush with member

1. Joist header
2. Foundation
3. Sill sealer
4. Crown
5. Joist hanger
6. Bridging
7. Span
8. Beam or girder
9. Termite shield
10. Sill
11. Anchor bolt
12. Subfloor
13. Joist

TEST

2. Identify floor and sill framing and support members illustrated below. Write the correct names in the blanks.

Anchor bolt
Wood "X" bridging
Termite shield
Double joist
Joist header
Beam or girder
Tail joist
Joist hanger
Solid bridging
Trimmer joist
Common joist
Sill
Pier
Subfloor



3. Name three methods used to fasten sills to the foundation.

a. ____

b. ____

c. ____

TEST

4. Select from the following list types of girders. Write an "X" in the blank before each correct type.

______a. Steel beam

______b. Partition wall

______c. Precast concrete

______d. Solid timber

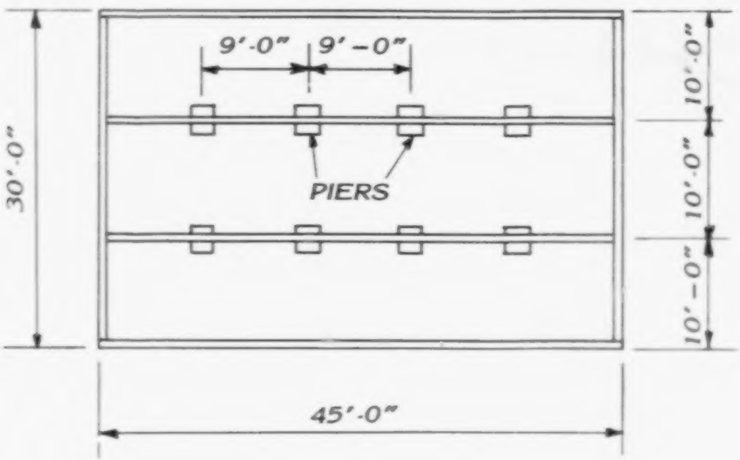
______e. 2 × 4 doubled

______f. Built-up timber

5. Determine proper girder size for safe use. Use the chart provided to figure the correct girder size if a built-up girder is to be in the following plan. The plan is for a first floor with a live load of 40 pounds per square foot and a dead load of 10 pounds per square foot.

Safe Girder Loads

Nominal girder size	Safe load in pounds for spans shown				
	6 Ft.	7 Ft.	8 Ft.	9 Ft.	10 Ft.
6 × 8 Solid	8,306	7,118	6,220	5,539	4,583
6 × 8 Built up	7,359	6,306	5,511	4,908	4,062
6 × 10 Solid	11,357	10,804	9,980	8,887	7,997
6 × 10 Built up	10,068	9,576	8,844	7,878	7,086
8 × 8 Solid	11,326	9,706	8,482	7,553	6,250
8 × 8 Built up	9,812	8,408	7,348	6,544	5,416
8 × 10 Solid	15,487	14,732	13,608	12,116	10,902
8 × 10 Built up	13,424	12,968	11,792	10,504	9,448



Size of built-up girder ______________________________

TEST

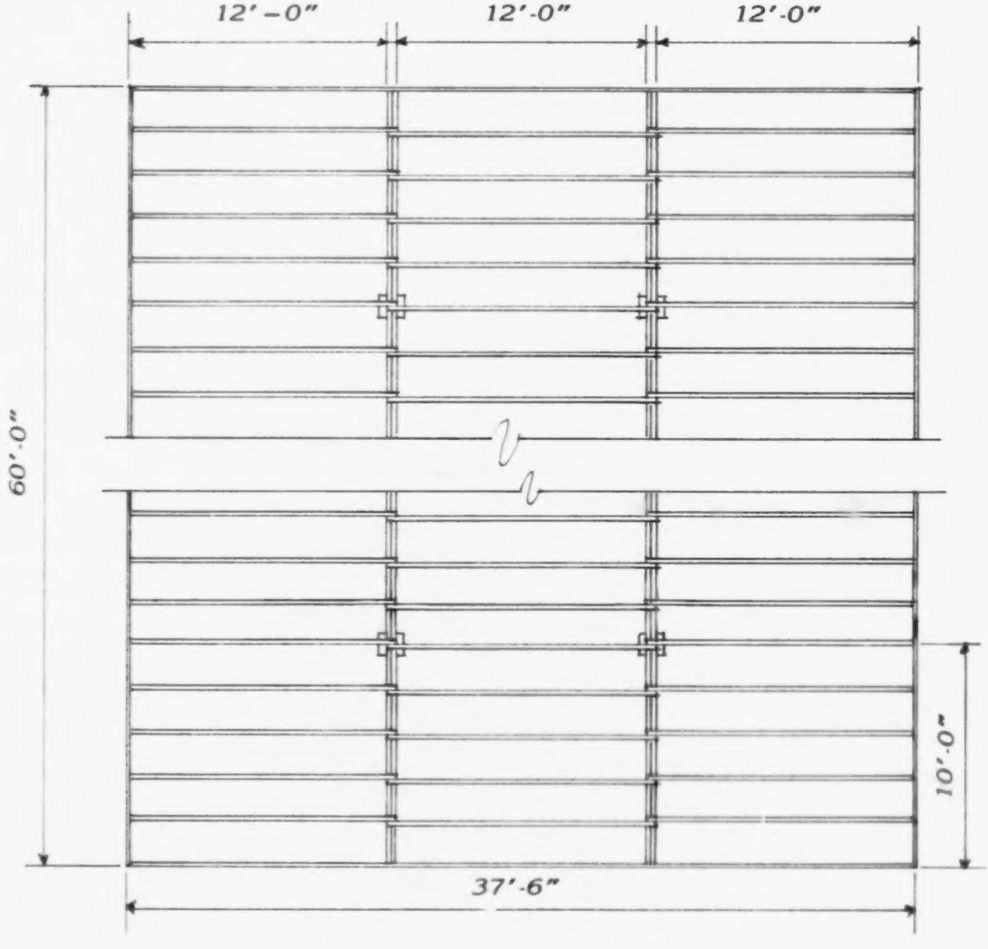
6. List three types of joists.

   a. ______________________________

   b. ______________________________

   c. ______________________________

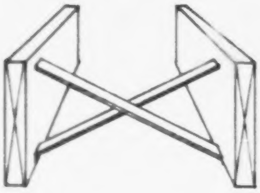
7. Determine proper joist size for ordinary load conditions in the illustration below. This construction will have plastered ceilings and a live load of 40 pounds per square foot.



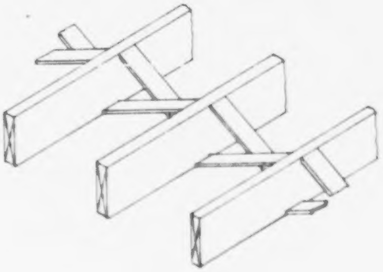
Size of joist ______________________________

TEST

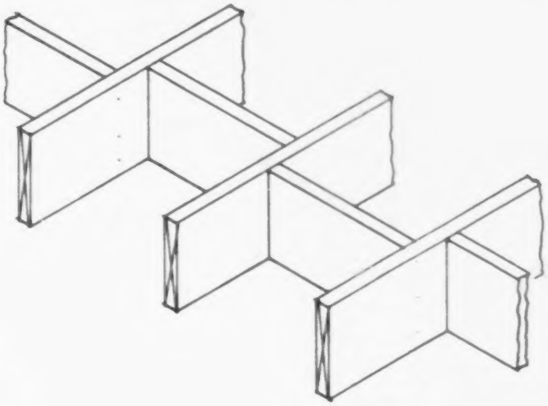
8. Identify the types of bridging illustrated below. Write the correct names in the blanks.



a. ______________________________



b. ______________________________



c. ______________________________

9. List four types of subflooring materials.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

TEST

10. Discuss functional designs used to lay subflooring. Describe the design, state the type of subflooring for which the design is suitable, and list at least one advantage or disadvantage compared to the other design.

    a. ______________________________

    ____

    ____

    b. ______________________________

    ____

    ____

11. List three purposes of subflooring.

    a. ______________________________

    ____

    b. ______________________________

    ____

    c. ______________________________

    ____

12. Match fasteners used in floor framing to their correct uses. Write the correct numbers in the blanks.

______a. Furnished to attach joist hangers

______b. Used to install subflooring, sheathing, wall paneling, and siding

______c. Used to install wood "X" bridging and subfloor

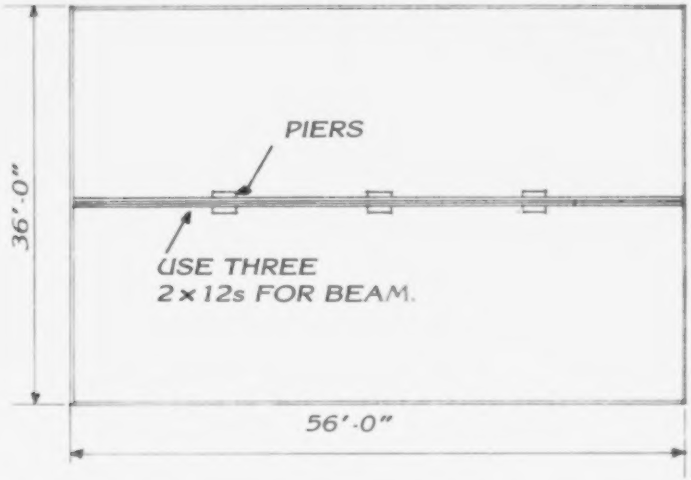
______d. Used to attach header to joist, to install solid bridging, and to construct beams and girders

______e. Used to apply subfloor

1. Special nails
2. 16d box nails
3. Construction glue or adhesive
4. 8d box nails
5. Pneumatic, ring-shank, and screw nails

TEST

13. Estimate amount of material needed to frame a floor and sill and to lay a subfloor for the house illustrated below.



a. Sill sealer ______

b. Termite shield ______

c. Sill (2×6s) ______

d. Beams (2×12s) ______

e. Joists (2×8s, 12" on center) ______

f. Joist headers (2×8s) ______

g. Bridging (solid lumber) ______

h. Subflooring (plywood) ______

(NOTE: Test question 14 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

14. Demonstrate the ability to

a. Build a box sill, install floor joists, and frame an opening.

b. Install bridging.

c. Lay diagonal and right-angle subfloors.

d. Install joists for a cantilever floor.

FLOOR AND SILL FRAMING
UNIT I

ANSWERS TO TEST

1. a. 9
   b. 13
   c. 7
   d. 1
   e. 11
   f. 4
   g. 10
   h. 2
   i. 6
   j. 12
   k. 8
   l. 3
   m. 5

2. a. Subfloor
   b. Wood "X" bridging
   c. Joist header
   d. Double joist
   e. Tail joist
   f. Trimmer joist
   g. Common joist
   h. Sill
   i. Solid bridging
   j. Joist hanger
   k. Pier
   l. Beam or girder
   m. Termite shield
   n. Sill sealer
   o. Anchor bolt

3. a. Anchor bolts
   b. Powder-actuated pins
   c. Metal plates or straps

4. a, c, d, f

5. 6×8 built-up girder

6. Answer should include any three of the following
   a. Solid wood
   b. Fabricated wood
   c. Steel bar
   d. Steel "C"
   e. Reinforced concrete

7. Size of joist - 2×8

8. a. Steel
   b. Wood "X" bridging
   c. Solid bridging

9. Answer should include any four of the following
   a. Shiplap lumber
   b. Tongue-and-groove lumber
   c. Common lumber

ANSWERS TO TEST

d. Plywood
e. Fiber board
f. Wafer board
g. Strand board
h. Particle board

10. a. Discussion should include

    Subflooring laid diagonally to joists may be used to lay shiplap, tongue-and-groove, or common lumber

    Answer should also include at least one of the following
    1) Permits finish floor to be laid in any direction
    2) Provides better than average bracing and stiffness to building
    3) Is preferred in homes of two or more stories

    b. Discussion should include

    Subflooring laid at right angles to joists may be used to lay any of the subfloor materials

    Answer should also include at least one of the following
    1) Requires that finish floor run parallel to joists (be laid at right angle to subfloor)
    2) Provides average bracing and stiffness to building
    3) Generally results in less waste than diagonal subfloors
    4) Requires less labor time to install than diagonal subfloors

11. Answer should include any three of the following
    a. Lending bracing strength to building
    b. Providing solid base for finish floor, thus making floor sag and squeaks less likely
    c. Acting as barrier to cold and dampness, thus keeping building warmer and drier in winter
    d. Providing a safe working surface for constructing the building

12. a. 1
    b. 3
    c. 4
    d. 2
    e. 5

13. a. 184 lineal feet
    b. 184 lineal feet
    c. 184 lineal feet
    d. 168 lineal feet of 2×12s or one 2×12 beam 56 feet long
    e. 114 joists - 20′ long
    f. 112 lineal feet
    g. 224 lineal feet 2×8s
    h. 63 pieces

14. Performance skills evaluated to the satisfaction of the instructor

WALL AND CEILING FRAMING
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to identify wall and partition members, estimate materials, and frame a single story structure. The student will show this knowledge by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with wall and ceiling framing to their correct definitions.
2. Identify framing members used in wall and partition framing.
3. Complete drawings of common methods used to construct outside corners of wall frames.
4. Complete drawings of common methods used to construct partition Ts.
5. Label types of headers.
6. Compute the length of a regular stud.
7. Compute rough opening (R.O.) dimensions for windows.
8. Compute rough opening (R.O.) dimensions for doors.
9. Compute the length of trimmers for window and door openings.
10. Compute the length of headers for rough openings.
11. Select from a list construction details that should be added during wall framing.
12. List methods used to brace walls.
13. Select from a list pennyweights of nails most often used in framing.
14. Estimate amount of materials for wall and partition framing.
15. Demonstrate the ability to
    a. Lay out wall and partition locations on floor.
    b. Cut studs, trimmers, cripples, and headers to length.
    c. Build corners, Ts, and headers.
    d. Construct wall sections for a single-story structure.
    e. Lay out and install ceiling joists.

WALL AND CEILING FRAMING
UNIT II

SUGGESTED ACTIVITIES

I. Unit contents

- A. Objective sheet
- B. Suggested activities
- C. Transparency masters
  1. TM #1 — Wall and Partition Framing Members
  2. TM #2 — Stud Length for a Slab Floor
  3. TM #3 — Stud Length for a Wood Floor
  4. TM #4 — Door and Window Headers
  5. TM #5 — Trimmer Studs
  6. TM #6 — Temporary Bracing
  7. TM #7 — Nails
  8. TM #8 — Lengths of Nails by Pennyweights
- D. Information sheet
- E. Assignment sheets
  1. Assignment Sheet #1 — Calculate Rough Opening Dimensions for Windows
  2. Assignment Sheet #2 — Estimate Materials for Wall and Partition Framing
- F. Answers to assignment sheets
- G. Job sheets
  1. Job Sheet #1 — Lay Out Wall and Partition Locations on Floor
  2. Job Sheet #2 — Cut Studs, Trimmers, Cripples, and Headers to Length
  3. Job Sheet #3 — Build Corners, Ts, and Headers
  4. Job Sheet #4 — Construct Wall Sections for a Single-Story Structure
  5. Job Sheet #5 — Lay Out and Install Ceiling Joists

SUGGESTED ACTIVITIES

H. Test

I. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Obtain materials necessary to supplement unit.

1. Order transparencies and competency profiles.

(NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, DC 20006, phone 202-393-2040.)

2. Order film *The Wood Shell.* Color, 30 minutes, 1982; Circle Oak Productions, 73 Girdle Ridge Drive, Katonah, New York 10536, telephone 914-232-9451.

This film finishes the house that *The Foundation* started, and includes the building of walls, floors, ceilings, and roof.

(NOTE: This film is available only to Oklahoma teachers on a free-loan basis from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074. Out-of-state teachers must order from the address listed with the film.)

C. Introduce unit.

SUGGESTIONS:

- Tour construction sites where frames have been erected; point out the planning behind the construction sequence and safety considerations such as bracing.
- Have students discuss the construction process and the steps involved in framing to gain some insight into the complexity of the task and the need for careful planning.
- Show students the film *The Wood Shell.*

D. Provide students with objective sheet.

E. Discuss unit and specific objectives, relating them to previous units and your introduction to this unit.

F. Provide students with information sheet.

SUGGESTED ACTIVITIES

G. Discuss information sheet.

1. Use Information Sheet, Section I to discuss terms associated with wall framing.

   SUGGESTIONS:

   - Use transparencies, an actual construction site, a model, or building plans to illustrate appropriate parts.
   - Provide students with door and window framing instructions that emphasize rough openings.

2. Use Information Sheet, Section II and Transparency #1 to discuss framing members.

   SUGGESTIONS:

   - Relate framing members to terms and definitions.
   - Use a model or a full-size wall to illustrate the parts, emphasizing how parts fit together to provide the required strength.

3. Use Information Sheet, Sections III and IV to discuss corner and partition T assemblies.

   SUGGESTIONS:

   - Construct a model of each type of assembly.
   - Discuss advantages and disadvantages of each type.
   - Discuss other types of assemblies.

4. Use Information Sheet, Section V and Transparency #4 to discuss types of headers.

   SUGGESTIONS:

   - Demonstrate the construction of each type of header.
   - Acquaint the students with the use of header schedules and header span charts.

5. Use Information Sheet, Section VI and Transparencies #2 and #3 to discuss computing the lengths of studs.

   SUGGESTIONS:

   - Demonstrate the calculation steps and translate them into the actual cutting and construction of stud framing.
   - Give the students problems with different finished ceiling heights and flooring to allow them to practice calculating stud lengths.

SUGGESTED ACTIVITIES

6. Use Information Sheet, Sections VII and VIII to discuss calculating rough opening sizes.

   SUGGESTIONS:

   - Show students how to determine finish opening height from plans.
   - Provide students with literature from window and door manufacturers to study rough opening specifications.
   - Build a rough opening to calculations and use shims to demonstrate what problems would be experienced if the rough opening were made too small.
   - Discuss other types of rough openings, such as those for patio doors, bifold doors, pocket doors, bay windows, fireplaces, etc.
   - Use Assignment Sheet #1 to allow students to practice calculating rough openings.

7. Use Information Sheet, Section IX and Transparency #5 to discuss computing trimmer lengths, relating the information to headers and rough openings.

8. Use Information Sheet, Section X to discuss header lengths.

   SUGGESTIONS:

   - Relate header length to rough opening size and the use of trimmers.
   - Emphasize the use of span charts and header schedules, giving the students problems to figure.

9. Use Information Sheet, Section XI to discuss framing details to consider during wall framing.

   SUGGESTIONS:

   - Invite a framing carpenter to talk to the class about how frame construction must coordinate with the other types of construction involved in a job.
   - Provide students with construction plans and ask them to identify details that require special consideration on the part of framers; discuss these requirements with the class.

10. Use Information Sheet, Section XII and Transparency #6 to discuss wall bracing.

    SUGGESTIONS:

    - Push an unbraced wall over to show the need for temporary bracing.

SUGGESTED ACTIVITIES

- Demonstrate the use of each type of permanent and temporary bracing.

- Demonstrate the use of gauge blocks in setting a straight wall.

11. Use Information Sheet, Section XIII and Transparencies #7 and #8 to discuss nails.

    SUGGESTIONS:

    - Provide students with copies of transparency masters.

    - Show students various sizes and types of nails; discuss their specific applications.

    - Demonstrate toenailing and other techniques.

    - Demonstrate pneumatic nailers and explain their use in framing.

12. Use Information Sheet, Section XIV to discuss material estimating.

    SUGGESTIONS:

    - Invite a building materials supplier to discuss types, dimensions, grades, and costs of wood used in wall and partition framing.

    - Use Assignment Sheet #2 to allow students practice in estimating materials.

    - Provide students with additional practice by allowing them to estimate materials from other sets of plans; allow students to order material whenever possible.

    - Emphasize the importance and cost savings of planning the cutting of material, with consideration given to trimmers, cripple studs, and blocking.

H. Provide students with job sheets.

I. Demonstate job sheet procedures and allow students to practice.

(NOTE: The procedure for laying out and installing ceiling joists has been included in this unit because this is the usual sequence in construction. However, you may want to cover part of the roof framing unit to help students understand the influence of roof design on joist layout.)

SUGGESTIONS:

- Try to get the students to plan the procedures and to visualize the construction process.

- Tour construction sites and allow students to watch framers at work.

SUGGESTED ACTIVITIES

- Review power tool safety and care and other safety information applicable to framing.

J. Review unit.

K. Give test.

L. Critique test and discuss in class.

M. Reteach and retest as necessary.

N. Complete appropriate sections of competency profiles.

III. Unit references

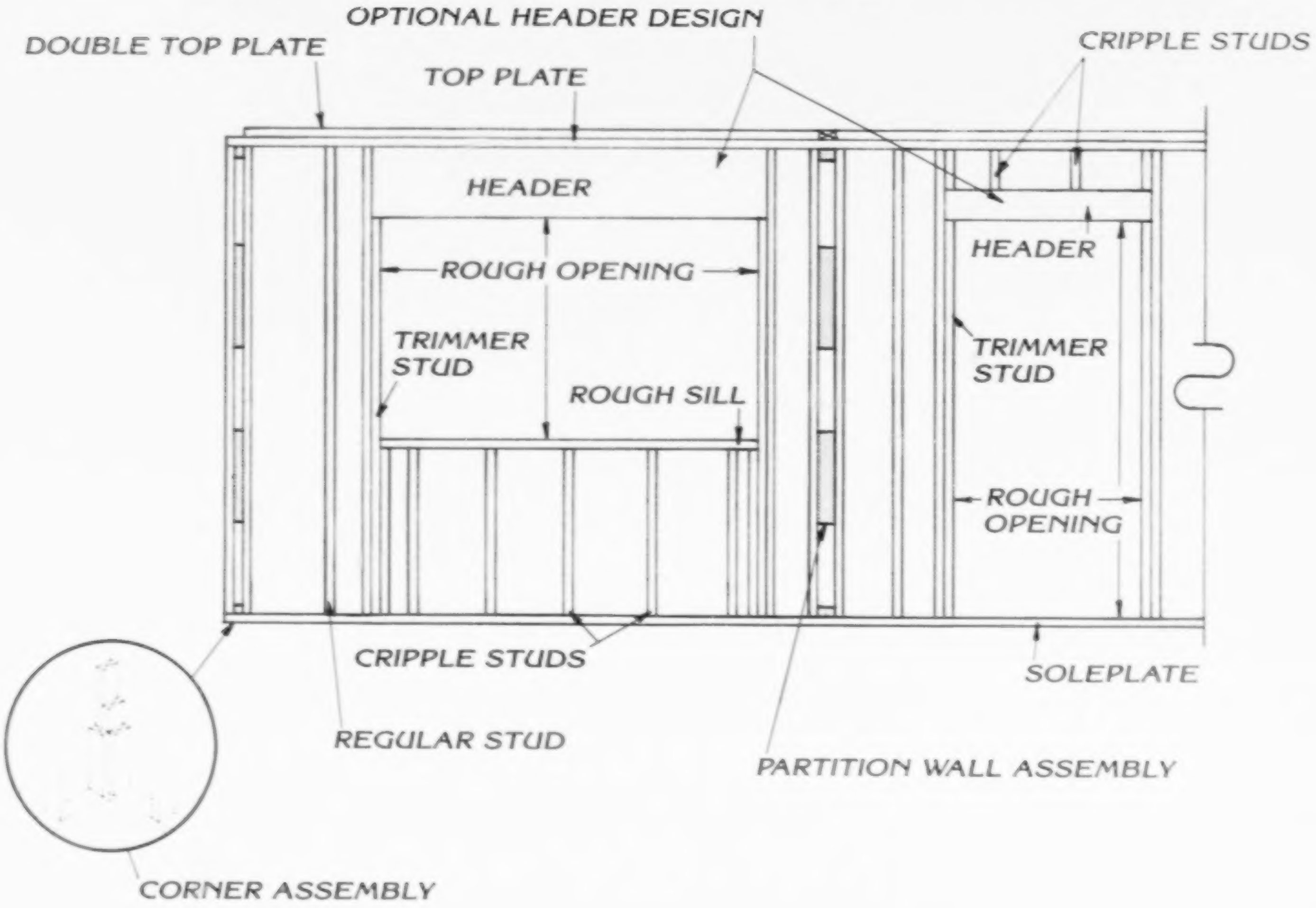
A. Hendrix, Laborn J. "Bud." *Commercial Carpentry*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1979.

B. Penner, Wayman R. *Residential Carpentry*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1973.

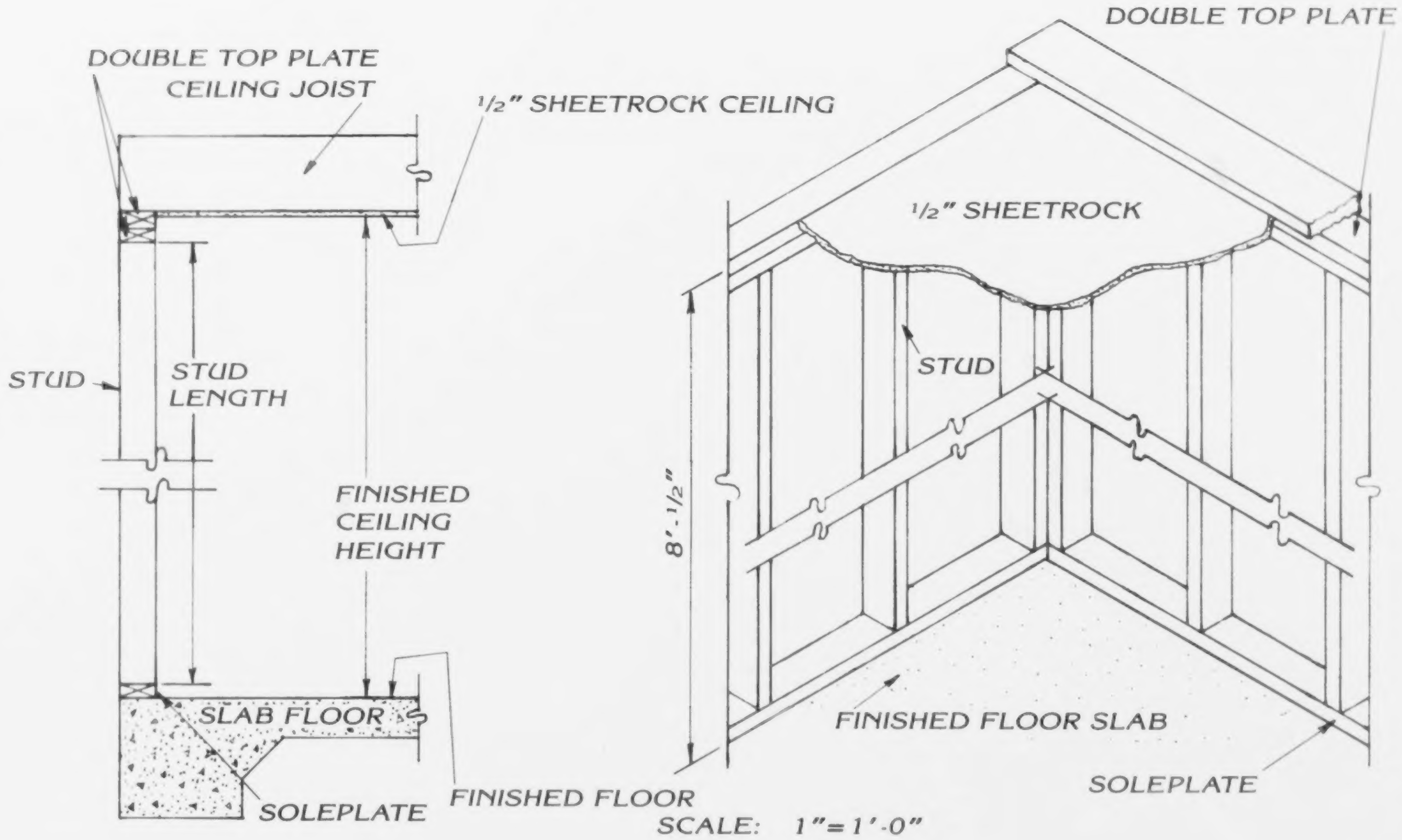
C. United Steel Products Company. Technical Information Procedure Sheet. Minneapolis, Minnesota, 1972.

D. Wagner, Willis H. *Modern Carpentry*. South Holland, Illinois: Goodheart-Willcox Co., Inc., 1976.

Wall and Partition Framing Members


OPTIONAL HEADER DESIGN
DOUBLE TOP PLATE
CRIPPLE STUDS
TOP PLATE
HEADER
ROUGH OPENING
HEADER
TRIMMER STUD
TRIMMER STUD
ROUGH SILL
ROUGH OPENING
CRIPPLE STUDS
SOLEPLATE
REGULAR STUD
PARTITION WALL ASSEMBLY
CORNER ASSEMBLY

Stud Length for a Slab Floor

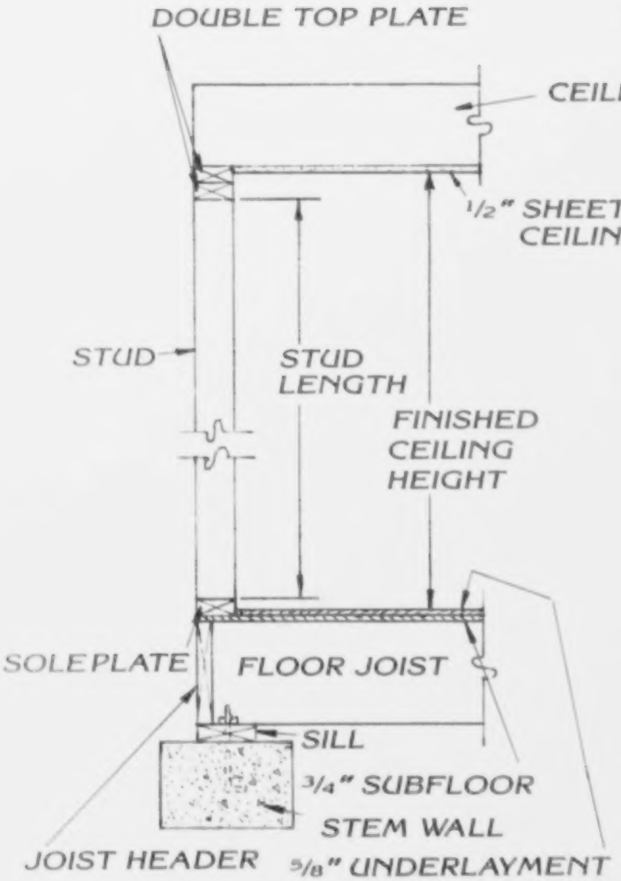

DOUBLE TOP PLATE
CEILING JOIST
1/2" SHEETROCK CEILING
STUD
STUD LENGTH
FINISHED CEILING HEIGHT
SLAB FLOOR
SOLEPLATE
FINISHED FLOOR
DOUBLE TOP PLATE
1/2" SHEETROCK
STUD
8'-1/2"
FINISHED FLOOR SLAB
SOLEPLATE

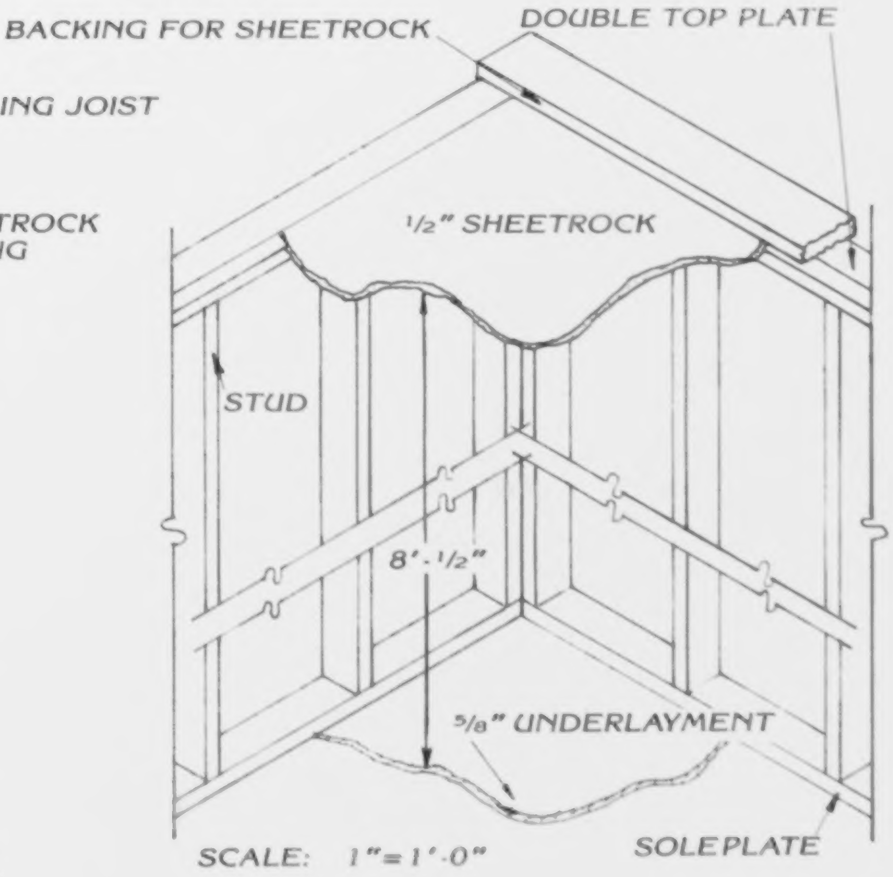
SCALE: 1"=1'-0"

TM #2

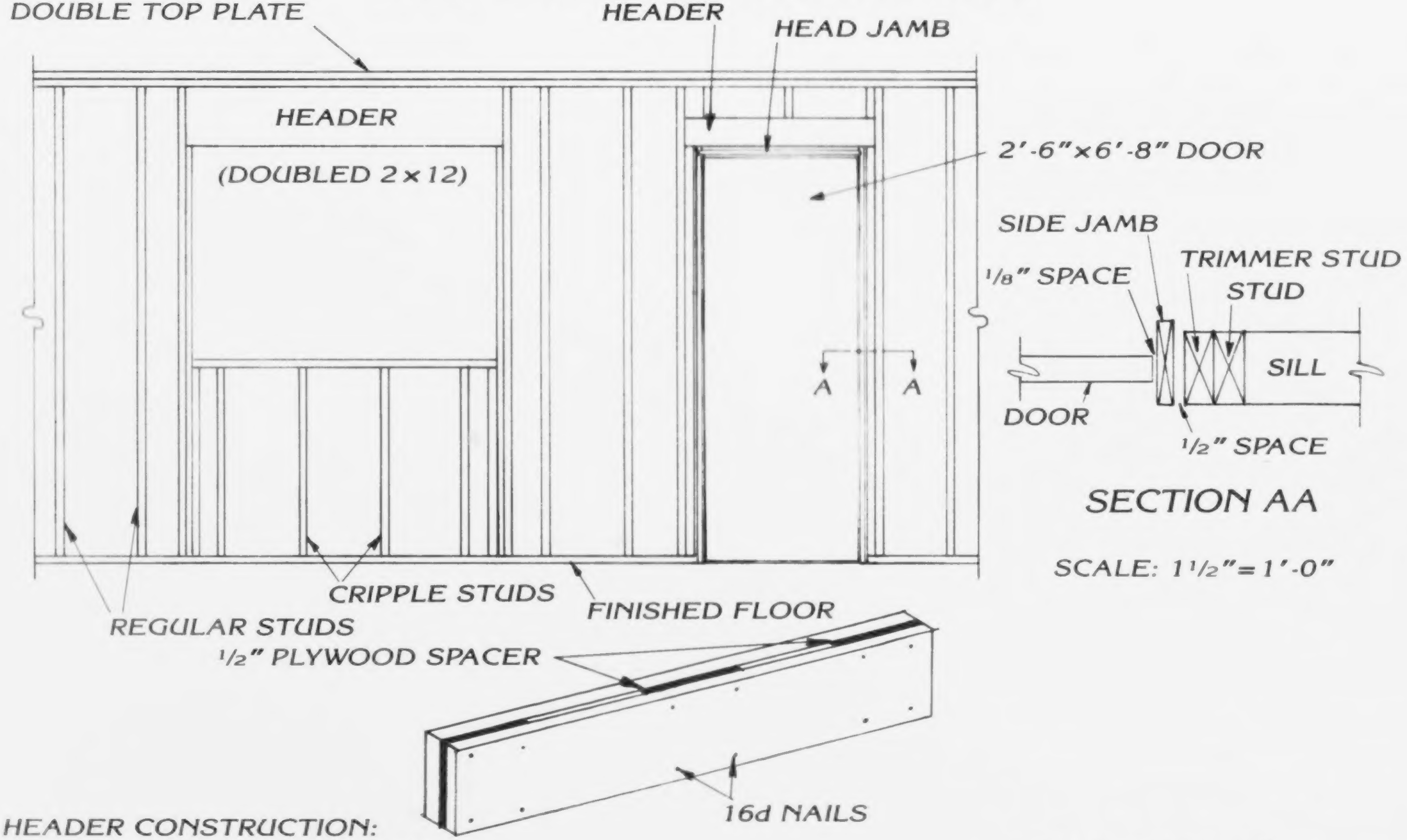
RC-77-D

Stud Length for a Wood Floor


DOUBLE TOP PLATE
CEILING JOIST
1/2" SHEETROCK CEILING
STUD
STUD LENGTH
FINISHED CEILING HEIGHT
SOLEPLATE
FLOOR JOIST
SILL
3/4" SUBFLOOR
STEM WALL
JOIST HEADER
5/8" UNDERLAYMENT


BACKING FOR SHEETROCK
DOUBLE TOP PLATE
1/2" SHEETROCK
STUD
8'-1/2"
5/8" UNDERLAYMENT
SOLEPLATE
SCALE: 1"=1'-0"

Door and Window Headers


DOUBLE TOP PLATE
HEADER
HEAD JAMB
HEADER
(DOUBLED 2×12)
2'-6"×6'-8" DOOR
A
A
SIDE JAMB
1/8" SPACE
TRIMMER STUD
STUD
SILL
DOOR
1/2" SPACE
CRIPPLE STUDS
FINISHED FLOOR
REGULAR STUDS
1/2" PLYWOOD SPACER
16d NAILS

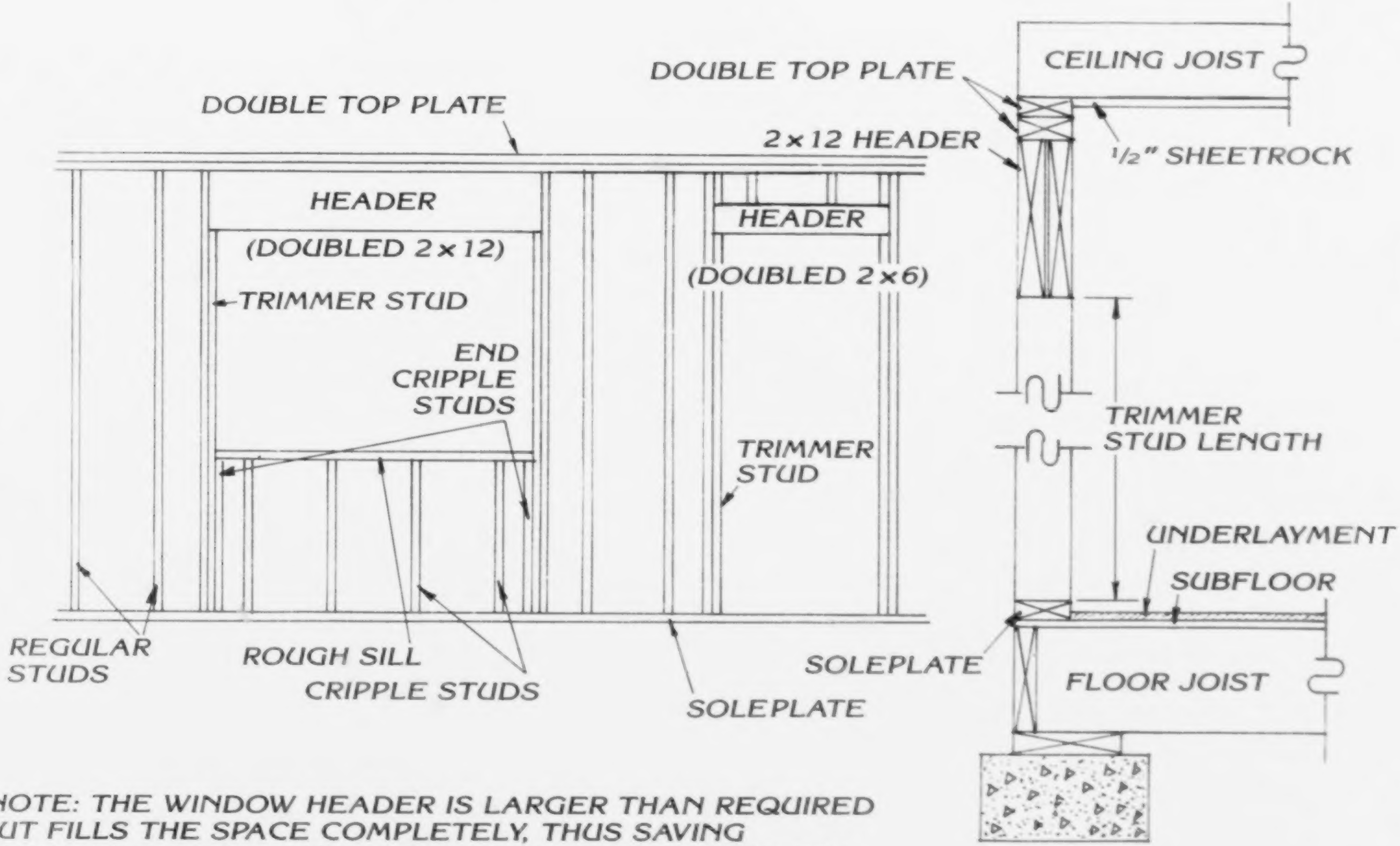
SECTION AA

SCALE: 1½"=1'-0"

HEADER CONSTRUCTION:
THE PLYWOOD SPACERS ARE
PLACED 16" TO 24" O.C.

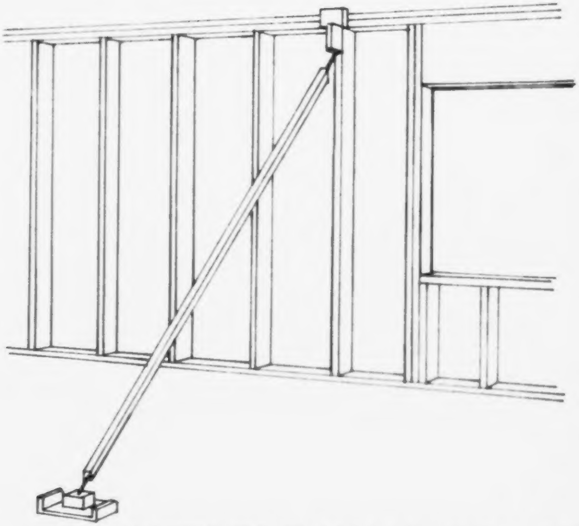
SCALE: 3/8"=1'-0"

Trimmer Studs

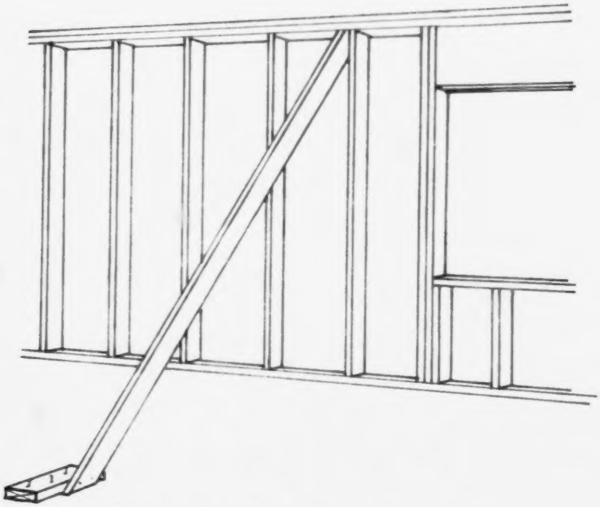

DOUBLE TOP PLATE
HEADER
(DOUBLED 2×12)
TRIMMER STUD
END CRIPPLE STUDS
HEADER
(DOUBLED 2×6)
TRIMMER STUD
REGULAR STUDS
ROUGH SILL
CRIPPLE STUDS
SOLEPLATE
DOUBLE TOP PLATE
CEILING JOIST
2×12 HEADER
1/2" SHEETROCK
TRIMMER STUD LENGTH
UNDERLAYMENT
SUBFLOOR
SOLEPLATE
FLOOR JOIST

(NOTE: THE WINDOW HEADER IS LARGER THAN REQUIRED BUT FILLS THE SPACE COMPLETELY, THUS SAVING LABOR IN CUTTING AND ASSEMBLING SHORT CRIPPLES.)

Temporary Bracing

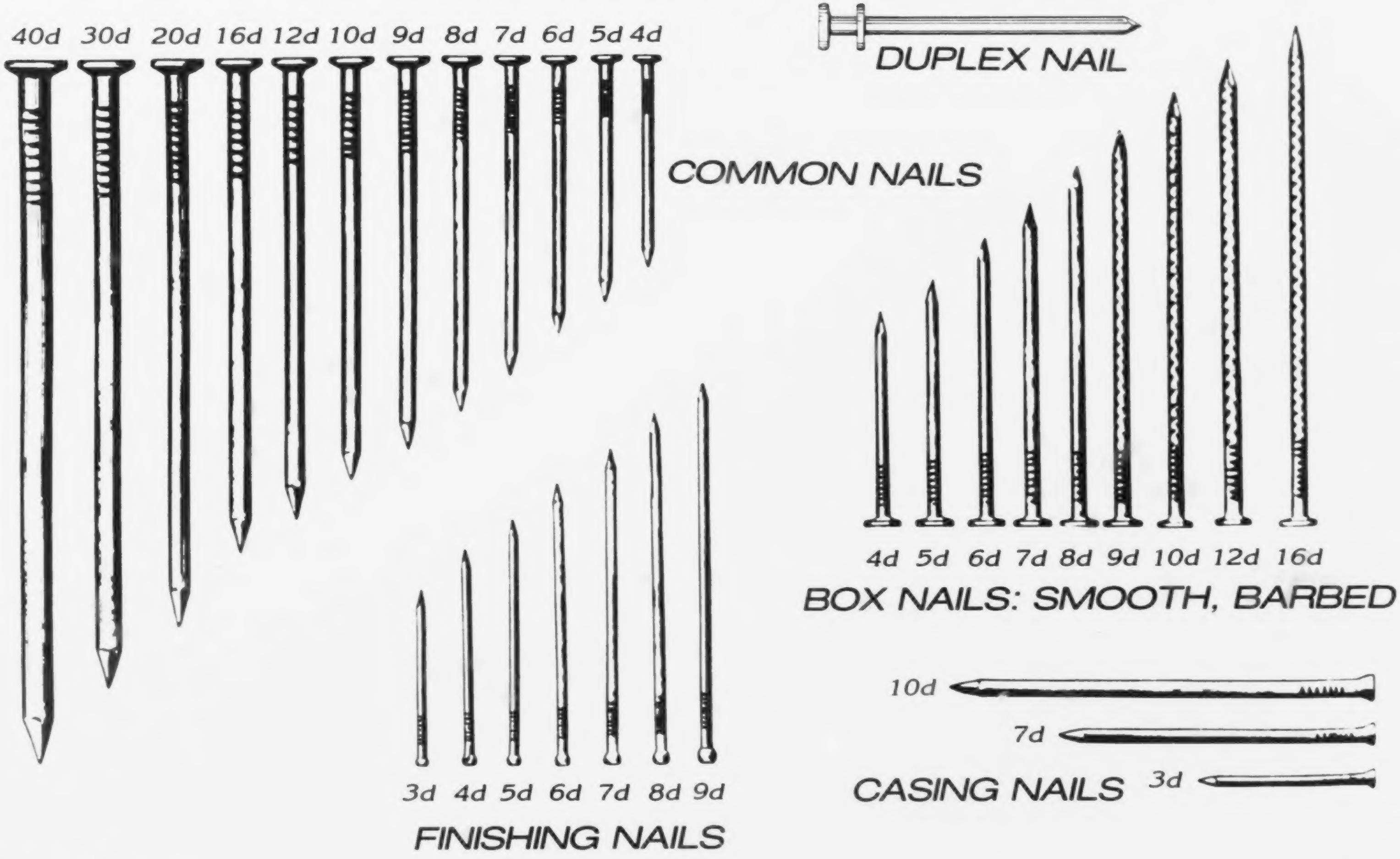


ADJUSTABLE WALL BRACE



2×4 WALL BRACE

Nails


40d 30d 20d 16d 12d 10d 9d 8d 7d 6d 5d 4d
COMMON NAILS
DUPLEX NAIL
4d 5d 6d 7d 8d 9d 10d 12d 16d
BOX NAILS: SMOOTH, BARBED
3d 4d 5d 6d 7d 8d 9d
FINISHING NAILS
10d
7d
3d
CASING NAILS

Lengths of Nails by Pennyweight

Pennyweight	Length in inches for common, box, and finish nails
2d	1
3d	1 1/4
4d	1 1/2
5d	1 3/4
6d*	2
7d	2 1/4
8d*	2 1/2
9d	2 3/4
10d	3
12d	3 1/4
16d*	3 1/2
20d*	4

* Sizes most often used in construction

WALL AND CEILING FRAMING
UNIT II

INFORMATION SHEET

I. Terms and definitions

   A. Bearing wall — Wall that supports the floors and roof directly above it in addition to its own weight

   B. Bearing partition — Partition wall that supports the structure above

   C. Partition — Wall that subdivides space within a building

   D. Stud — Main vertical framing member in walls and partitions

   E. Soleplate — Lowest horizontal member of a wall or partition to which the studs are nailed; rests on the rough floor

   F. Top plate — Upper horizontal structural member of a wall used to carry the rafters or trusses of a roof

   G. Double top plate — Top plate made of two members to allow better stiffening of the wall and for tying together splices, corners, and partitions that are at right angles to a wall

   H. Cripple stud — Any part of a framing stud that is cut less than full size, as over a door, window, or under a window opening

   I. Blocking (spacer) — Wood block used as filler piece and support between framing members

   J. Header — Horizontal structural member that supports the load over an opening, such as a window or door

   K. Jamb — Top and sides of a door or window frame that contacts the door or window sash; consists of a head jamb and side jambs

   L. Rough opening — Opening in framing formed by framing members, such as for windows and doors

   M. Rough sill — Lower framing member attached to the top of the bottom cripple studs to form the base of a rough opening for a window

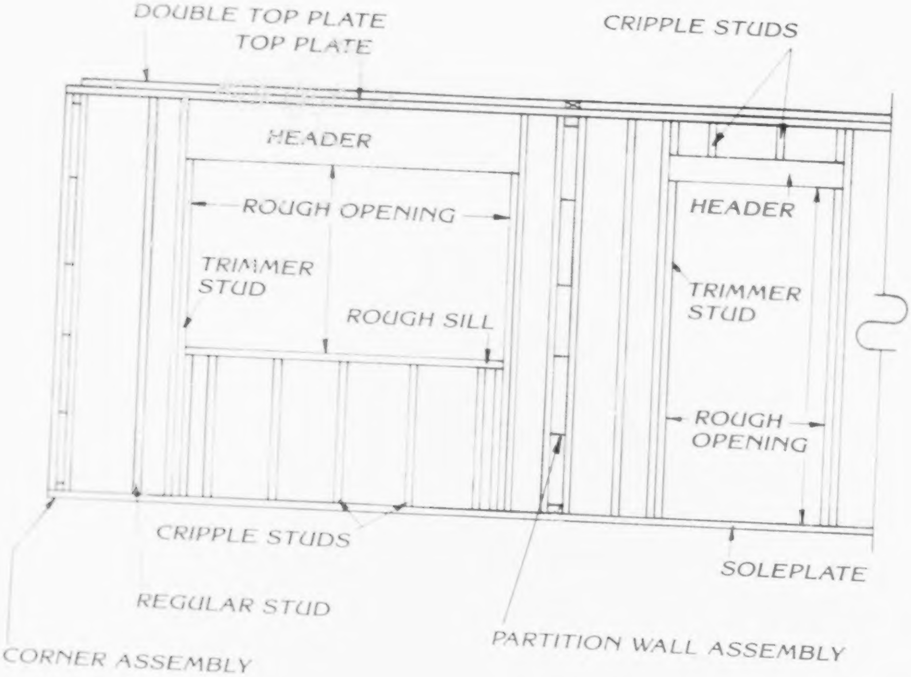
   N. Trimmer — Vertical framing member that forms the sides of rough openings for doors and windows and on which the header rests

   O. Gable — Triangular portion of exterior wall above the eaves at the end of a structure

INFORMATION SHEET

II. Wall and partition framing members (Figure 1)

FIGURE 1


DOUBLE TOP PLATE
TOP PLATE
CRIPPLE STUDS
HEADER
ROUGH OPENING
TRIMMER STUD
ROUGH SILL
HEADER
TRIMMER STUD
ROUGH OPENING
CRIPPLE STUDS
SOLEPLATE
REGULAR STUD
PARTITION WALL ASSEMBLY
CORNER ASSEMBLY

INFORMATION SHEET

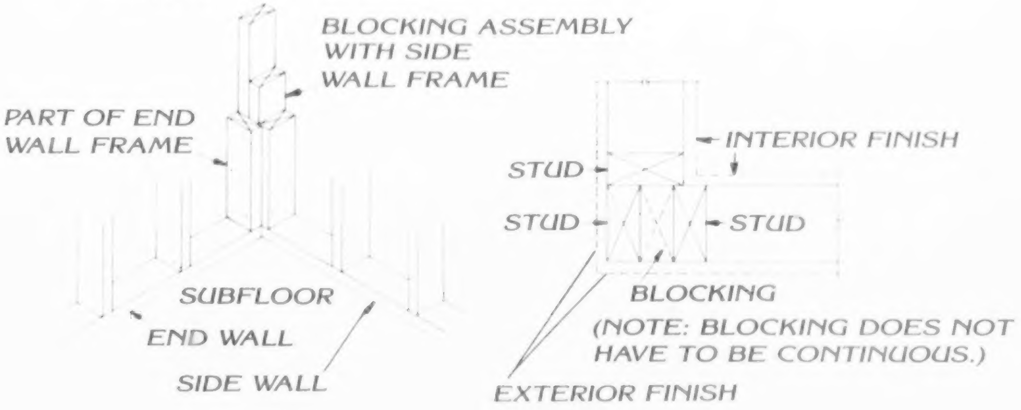
III. Methods used to construct outside corners of wall frame (Figures 2 and 3)

(NOTE: The methods shown are just two possible methods; many others exist. The important considerations are a solid corner and nailing surfaces for the interior and exterior wall finishes. Most carpenters try to choose the straightest, least defective studs for corner assemblies. The methods shown can be used for 2×4 or 2×6 studs.)

A. Constructed with three full studs and blocking

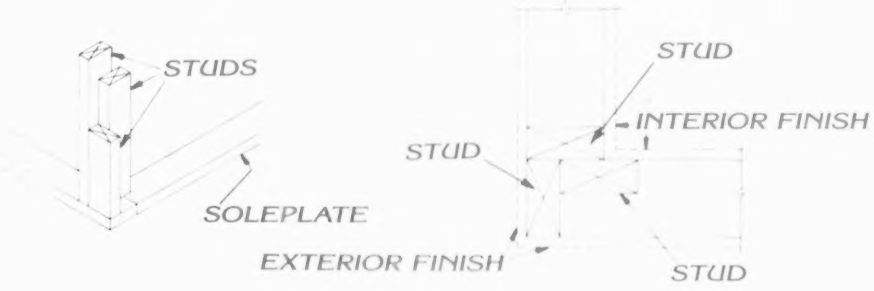
(NOTE: This is the most common method used.)

FIGURE 2


BLOCKING ASSEMBLY WITH SIDE WALL FRAME
PART OF END WALL FRAME
SUBFLOOR
END WALL
SIDE WALL
INTERIOR FINISH
STUD
STUD
STUD
BLOCKING
(NOTE: BLOCKING DOES NOT HAVE TO BE CONTINUOUS.)
EXTERIOR FINISH

B. Constructed with three full studs (no blocking)

FIGURE 3


STUDS
SOLEPLATE
STUD
INTERIOR FINISH
STUD
EXTERIOR FINISH
STUD

INFORMATION SHEET

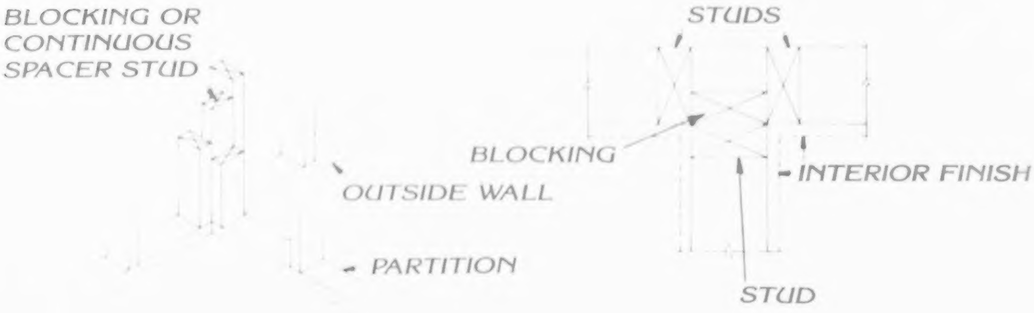
IV. Methods used to construct partition Ts (Figures 4-6)

(NOTE: Several methods for tying in partition walls exist. Some of the more common are shown here.)

A. Constructed with three studs and blocking

(NOTE: This is the most common method and can be used with 2×4 or 2×6 studs.)

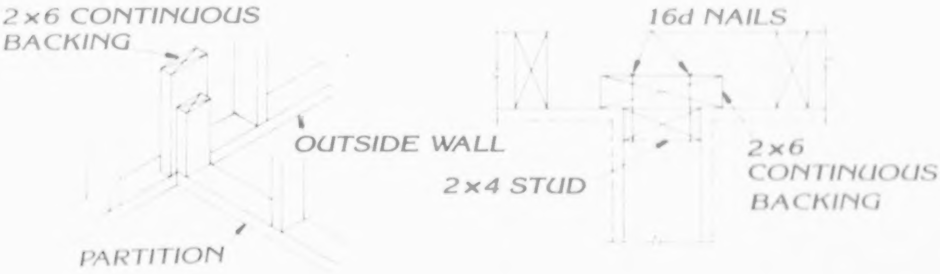
FIGURE 4


BLOCKING OR
CONTINUOUS
SPACER STUD
OUTSIDE WALL
PARTITION
STUDS
BLOCKING
INTERIOR FINISH
STUD

B. Constructed with a continuous backer

(NOTE: The method shown is for 2×4 framing, but variations exist for 2×6 framing.)

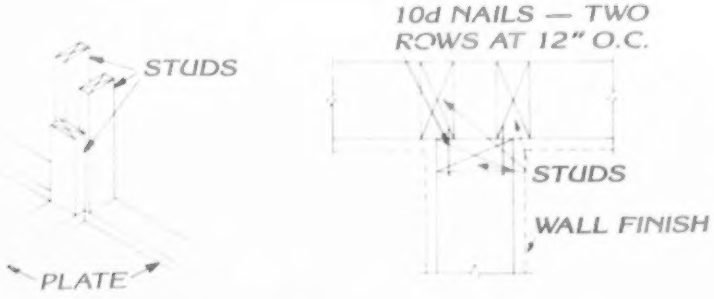
FIGURE 5


2×6 CONTINUOUS
BACKING
OUTSIDE WALL
PARTITION
16d NAILS
2×4 STUD
2×6
CONTINUOUS
BACKING

INFORMATION SHEET

C. Constructed with three studs (no blocking)

FIGURE 6


STUDS
PLATE
10d NAILS — TWO ROWS AT 12" O.C.
STUDS
WALL FINISH

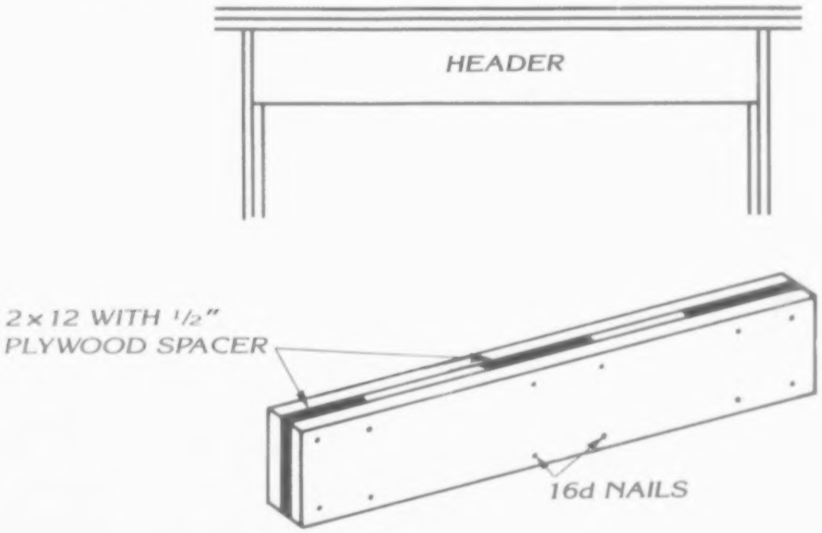
V. Types of headers

(NOTE: There are many different types of headers. These are some of the most common.)

A. Solid or full header (Figure 7)

(NOTE: Full header is used for large openings and fills the area from the rough opening to the bottom of the top plate.)

FIGURE 7

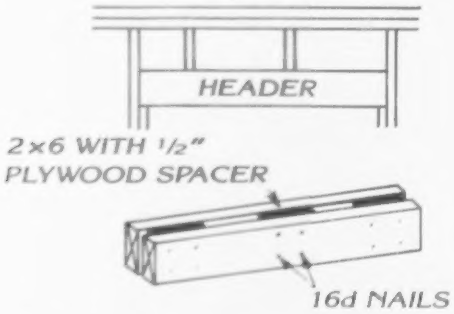

HEADER
2×12 WITH 1/2" PLYWOOD SPACER
16d NAILS

INFORMATION SHEET

B. Small header with cripples (Figure 8)

(NOTE: A small header with cripples may be used for average size windows and doors and is usually constructed of 2×4s or 2×6s.)

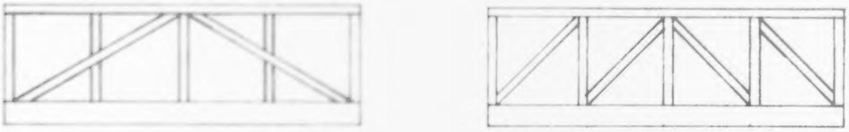
FIGURE 8


HEADER
2×6 WITH 1/2"
PLYWOOD SPACER
16d NAILS

C. Truss header (Figure 9)

(NOTE: Truss headers are used when the load is especially heavy or the span is extra wide. The design of trusses is usually included in the architectural plans.)

FIGURE 9



D. I-beam header (Figures 10 and 11)

FIGURE 10

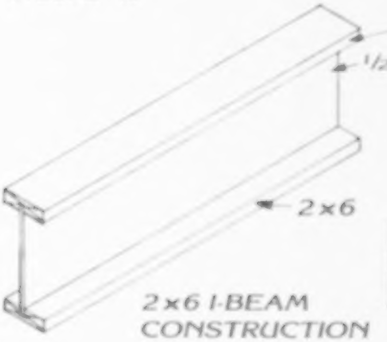
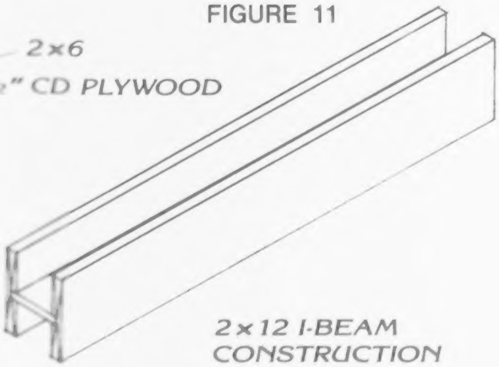

2×6
1/2" CD PLYWOOD
2×6
2×6 I-BEAM
CONSTRUCTION

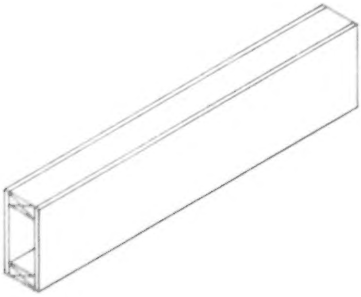
FIGURE 11


2×12 I-BEAM
CONSTRUCTION

INFORMATION SHEET

E. Box beam header (Figure 12)

FIGURE 12



VI. Computing the length of a regular stud

(NOTE: Precut studs are available in 92⅝-inch or 93¼-inch lengths.)

A. Slab floor

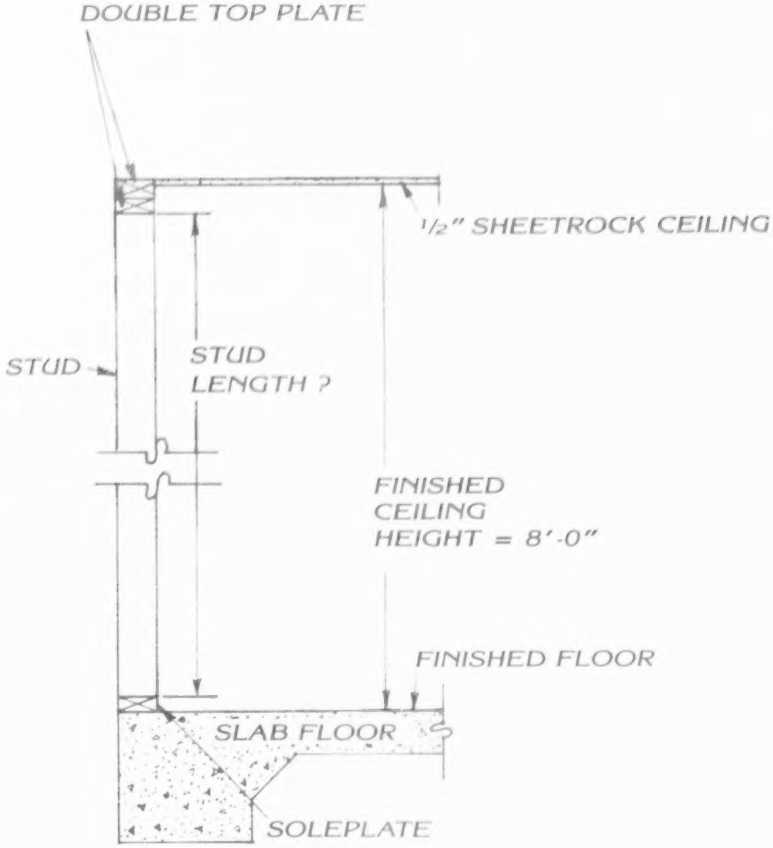
1. Determine the height of the finished ceiling from the finished floor including ½-inch clearance for finish material
2. Determine the thickness of the soleplate plus the double top plate
3. Determine the thickness of ceiling material and flooring material

   (NOTE: For carpet or a resilient-type flooring material, the thickness is negligible.)
4. Add the thickness of ceiling and flooring material to the finished ceiling height
5. Subtract the thickness of the plates from the sum achieved in step 4 to obtain the stud length

   EXAMPLE: The desired finished ceiling height is 8 feet, the actual plate thickness is 1 ½ inches, the ceiling thickness is ½ inch, and resilient tile flooring is used. (See Figure 13.)

INFORMATION SHEET

FIGURE 13


DOUBLE TOP PLATE
1/2" SHEETROCK CEILING
STUD
STUD LENGTH ?
FINISHED CEILING HEIGHT = 8'-0"
FINISHED FLOOR
SLAB FLOOR
SOLEPLATE

1. *Finished ceiling height: 8'*
2. *Thickness of soleplate and double top plate: 1 1/2" + 1 1/2" + 1 1/2" = 4 1/2"*
3. *Thickness of ceiling and flooring: 1/2" + 0 = 1/2"*
4. *Total wall frame required height: 8' + 1/2" = 8'- 1/2"*
5. *Required stud length: 8'- 1/2" − 4 1/2" = 7'-8" or 92"*

B. Wood floor

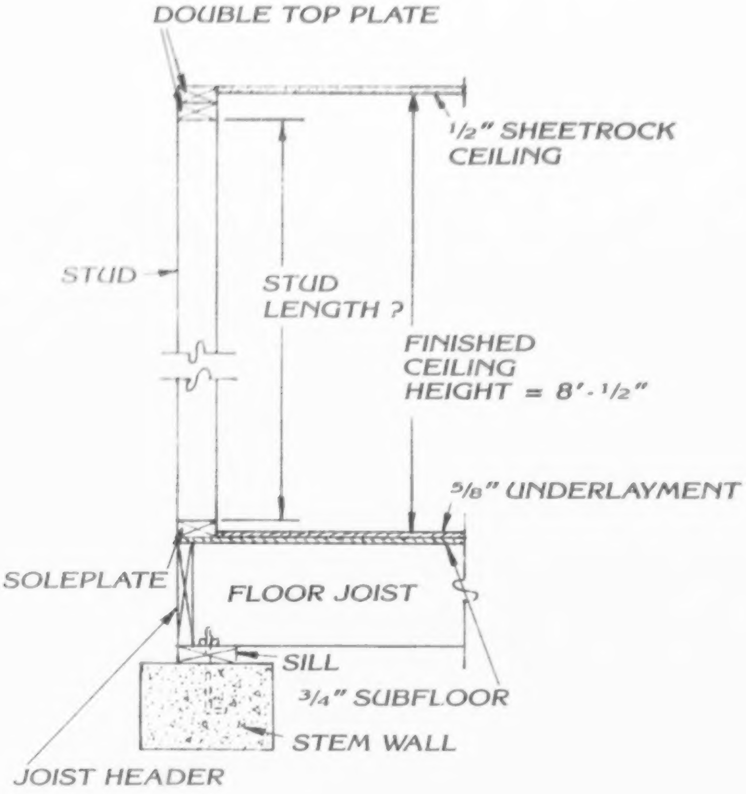
   1. Determine the height of the finished ceiling from the finished floor including 1/2-inch clearance for finish material
   2. Determine the thickness of the soleplate plus the double top plate
   3. Determine the thickness of ceiling material and underlayment
   4. Add the thickness of ceiling and underlayment to the finished ceiling height

INFORMATION SHEET

5. Subtract the thickness of the plates from the sum achieved in step number four for the stud length

EXAMPLE: The desired finished ceiling height is 8'-½", the actual plate thickness is 1 ½ inches, the ceiling thickness is ½ inch, and the underlayment thickness is ⅝ inch. (See Figure 14.)

FIGURE 14


DOUBLE TOP PLATE
½" SHEETROCK CEILING
STUD
STUD LENGTH ?
FINISHED CEILING HEIGHT = 8'-½"
⅝" UNDERLAYMENT
SOLEPLATE
FLOOR JOIST
SILL
¾" SUBFLOOR
STEM WALL
JOIST HEADER

1. *Height of finished ceiling: 8'-½"*
2. *Thickness of soleplate and double top plate: 1½" + 1½" + 1½" = 4½"*
3. *Thickness of ceiling material and underlayment: ½" + ⅝" = 1⅛"*
4. *Total wall frame required height: 8'-½" + 1⅛" = 8'-1⅝"*
5. *Required stud length: 8'-1⅝" − 4½" = 7'-9⅛" or 93⅛"*

INFORMATION SHEET

VII. Computing rough opening (R.O.) dimensions for windows (Figure 15)

(NOTE: Rough openings and other sizes are usually furnished by manufacturer; however, some windows consist of a combination of ventilating and fixed units, and the carpenter may need to calculate the rough opening dimensions.)

A. Compute horizontal distance for rough opening

1. Add width of window or windows

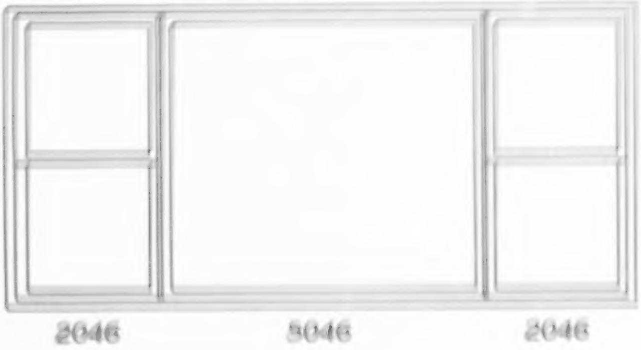
2. Add width of mullions if required

3. Add two inches for sides of rough opening

B. Add two inches for top and bottom to window height for vertical rough opening

EXAMPLE:

FIGURE 15



Horizontal rough opening

#1 Sash Opening — 2046	2'-0"
#2 Sash Opening — 5046	5'-0"
#3 Sash Opening — 2046	2'-0"
2 mullions (1" each)	0'-2"
Add 1" each side for R.O.	+ 0'-2"
	9'-4"

Vertical rough opening 4'-6" + 2" = 4' - 8"

INFORMATION SHEET

VIII. Compute rough opening (R.O.) dimensions for doors

A. Width

1. Check door schedule for door size
2. Add 3/16 inch to door width for clearance between door and side jambs
3. Add 1 1/2 inches (3/4 inch each) for side jambs
4. Add 3/4 inch (3/8 inch each) for clearance between jamb and trimmer stud
5. *Round to the next larger half inch to obtain the actual rough opening width*

EXAMPLE:

3'-0" x 7'-0" door

Door width	*3'-0"*
Door and jamb clearance	*3/16"*
Side jambs	1 1/2"
Side jamb and trimmer clearance	+ 3/4"
Exact rough opening width	3'-2 7/16"
Actual rough opening width	3'-2 1/2"

B. Height

1. Check door schedule for door size
2. Add 3/32 inch to door height for clearance between door and header jamb
3. Add 3/4 inch for header jamb
4. Add 5/8 inch for clearance under door
5. Add 3/8 inch for header jamb and rough header clearance
6. Round to the next larger half inch to obtain the actual rough opening width (See example on next page)

EXAMPLE:

3'-0" x 7'-0" door

Door height	7'-0"
Door and header clearance	3/32"
Header jamb	3/4"
Header jamb and rough header clearance	3/8"
Bottom clearance	+ 5/8"
Exact rough opening height	7'-1 27/32"
Actual rough opening height	7'-2"

IX. *Computing length of trimmers for window and door openings*

(NOTE: The tops of all windows and doors should be the same height from the floor unless otherwise specified. To compensate for variation in materials, the tops of the trimmers may be scribed.)

A. Slab floor

1. Determine the height of the rough opening from the finished floor
    a. Determine the door height and add 5/8 inch for clearance at the bottom of the door

       (NOTE: Standard doors are 6'-8" high.)

    b. Add 3/4 inch for jamb header
    c. Add 3/4 inch for clearance between rough header and jamb header
2. Subtract the thickness of the soleplate

EXAMPLE:

Door height	6'-8"
Clearance	5/8"
Jamb header	3/4"
Header clearance	+ 3/4"
	6'-10 1/8"
Soleplate	− 1 1/2"
Trimmer stud length	6'- 8 5/8"

(NOTE: Normal rough opening for a 6'-8" door should be 6'-10".)

INFORMATION SHEET

B. Wood floor — Compute the same as for a slab floor, remembering to add the thickness of the underlayment to establish the finished floor

X. Computing length of headers for rough openings

A. Rough header length for doors

(NOTE: If prehung doors are used, check manufacturer's specifications for rough opening size.)

1. Determine rough opening width
2. Check door schedule for door sizes
3. Add 1 ½" for side jambs
4. Add 1" for clearance to install jambs
5. Add 3" to rough opening width for trimmer studs

EXAMPLE:

For a 3'-0" × 6'-8" door

Door size	3'-0"
Side jambs	1½"
Side jambs and trimmer clearance	+ 1"
Rough opening	3'-2½"
Thickness of trimmer studs	+ 3"
Header size	3'-5½" or 41 ½"

(NOTE: After computing one header size, subtract the door size from it and use this figure to add to other door sizes to determine header size. You can generally use 5 ½ inches added to the door width.)

B. Rough header length for windows — Check with manufacturer to determine rough opening size, then add the thickness of the two trimmer studs, also taking into account whether the return on metal windows is to be Sheetrock or wood (See Table 1)

(NOTE: Table 1 gives the size of headers normally required for various rough opening widths with several load conditions. It is to be used as a guide only. Refer to plans and local regulations for additional restrictions.)

INFORMATION SHEET

TABLE 1 Maximum span for headers (exterior)

Header material	Load		
(Two members on edge)	Single Story	Two Story	Three Story
2×4	3′-6″	2′-6″	2′
2×6	6′	5′	4′
2×8	8′	7′	6′
2×10	10′	8′	7′
2×12	12′	9′	8′

XI. Construction details that should be added during wall framing

A. Openings for heating ducts

B. Supports for plumbing fixtures

C. Framing for recessed cabinets and electrical panels

D. Supports for towel bars

E. Backings for various appliances

F. Rough openings for air ducts, exhaust fans, and disappearing stair units

G. Corner blocks for nailing base

H. Framing for chimney and fireplace

I. Framing for pocket-type sliding doors

J. Rough openings for stairwells

XII. Methods used to brace walls

A. Permanent bracing

1. Plywood sheathing (at least on the corners)

2. Let-in corner bracing with 1×4 solid lumber

(NOTE: This type of bracing is done by marking each stud, cutting out a recess in each stud the thickness of the brace, and then nailing the brace in place so that the face of brace is flush with face of each stud.)

3. Metal bracing

INFORMATION SHEET

B. Temporary bracing (wind bracing)

1. 2×4 wall brace (used inside or outside)
2. Adjustable, metal wall brace

XIII. Pennyweights of nails most often used in framing

A. 6d

B. 8d

C. 16d

D. 20d

XIV. Estimating amount of materials needed for wall and partition framing

A. Wall plates (2×4s or 2×6s)

1. Determine the lineal footage of all outside walls, including openings
2. Determine the lineal footage of all inside walls, including partitions and openings
3. Multiply the total inside and outside lineal footage by three

   (NOTE: There are three plates: soleplate, top plate, and double top plate. Soleplate should be treated if used on concrete.)

4. Divide total lineal footage obtained in step number three by sixteen and round up to the next full number to get the number of sixteen-foot 2×4s needed for plates

   (NOTE: Plate material is usually ordered in sixteen-foot lengths.)

B. Studs, 16 inches on center

(NOTE: Studs may be purchased precut or may be cut on the job from eight foot or sixteen-foot 2×4s or 2×6s.)

1. Determine the lineal footage of all outside and inside walls
2. Allow one stud for each lineal foot of wall
3. If sixteen-foot material is used, divide the total achieved in step number one by two for the number of pieces of sixteen-foot material needed for studs

C. Studs for gable ends

1. On buildings with gable roofs, use one-half the plate length for determining the number of gable studs needed on 2'-0" centers at each gable end
2. Multiply one-half the plate length by three-quarters if the gable studs are on 16-inch centers to determine the number needed

INFORMATION SHEET

3. Determine to the nearest whole foot the length of the longest gable stud from the double plate to the top of the roof

   (NOTE: One piece of stud material will make a long and a short gable stud; this is why only one-half of the plate length is used.)

4. Order number calculated in step 2 or 3 in the next longest length

D. Headers

(NOTE: The use of 2×12 headers requires more material, but the time saved more than makes up for the difference.)

1. From the door and window schedule determine size of all doors and windows

   (NOTE: List each door and window separately.)

2. Add 5 ½ inches to each door and window width

3. Double the length of header for each door and window

4. Combine lengths obtained in step 3 into convenient lengths for ordering and to minimize waste

   EXAMPLE: For three headers of 4′-10″, 4′-10″, and 3′-11″, use 14-foot 2×12s

5. Order enough ½-inch CD plywood to cut up for spacers

E. Diagonal bracing (if used)

(NOTE: Diagonal bracing is required at each end of all exterior walls. These braces run from bottom plate at an approximate angle of 45 degrees. Walls 8′-0″ high would require material twelve feet long for each brace.)

1. Determine the number of outside and inside corners in the exterior walls

2. Multiply the number of corners by two to determine the number of twelve-foot 1×4s or metal strips needed for bracing

F. Ceiling joists on sixteen-inch centers

1. Determine the size of joists needed from specifications

2. Determine the length of the longest wall

3. Order number of ceiling joists equal to one more than three fourths times the wall length

   (NOTE: A building greater than sixteen feet wide will require a combination of lengths of joists.)

WALL AND CEILING FRAMING
UNIT II

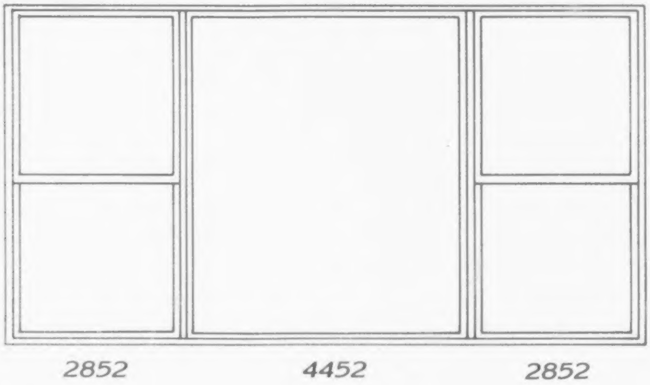
ASSIGNMENT SHEET #1 — CALCULATE ROUGH OPENING DIMENSIONS FOR WINDOWS

NAME ______________________________ SCORE ______________

To install windows properly, a carpenter must be able to calculate sizes of rough openings. The rough opening must provide a secure setting for the window while allowing the carpenter enough room to work.

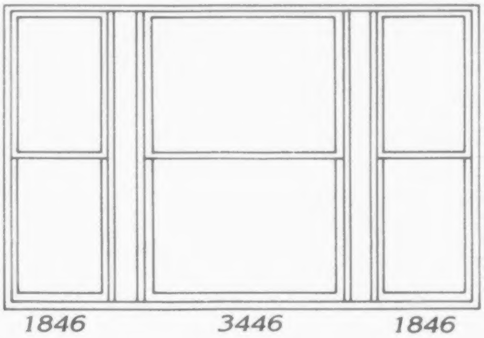
Calculate rough opening dimensions for the combination units listed. Give both the width and the height.

A. Combination double-hung and fixed windows with $1\frac{1}{2}$-inch mullions



Rough opening width ____________ height ____________

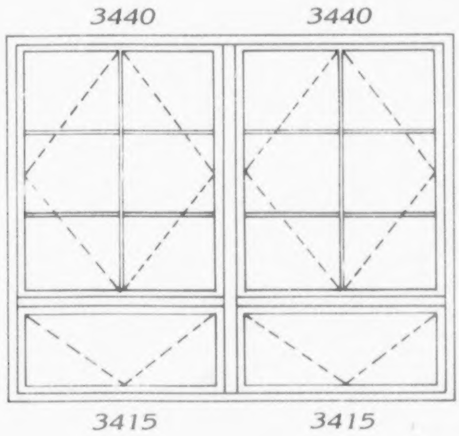
B. Combination of three double-hung windows with 4-inch mullions



Rough opening width ____________ height ____________

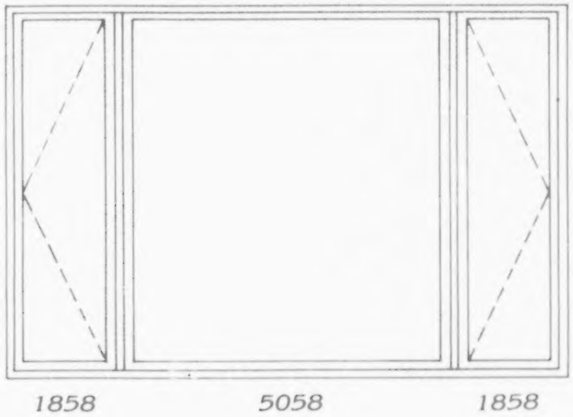
ASSIGNMENT SHEET #1

C. Combination casement and awning windows with 2-inch mullions


3440
3440
3415
3415

Rough opening width ____________ height ____________

D. Combination multi-use and fixed windows with 1½-inch mullions


1858
5058
1858

Rough opening width ____________ height ____________

WALL AND CEILING FRAMING
UNIT II

ASSIGNMENT SHEET #2 — ESTIMATE MATERIALS FOR WALL AND PARTITION FRAMING

NAME ______________________________ SCORE ____________

An accurate estimate of framing material saves time and money. Calculate the framing material needed for wall and partition framing from the floor plan on the next page.

A. Wall plates (2×4s, 16 feet long)______________________________

B. Studs (2×4s, 16 feet long)______________________________

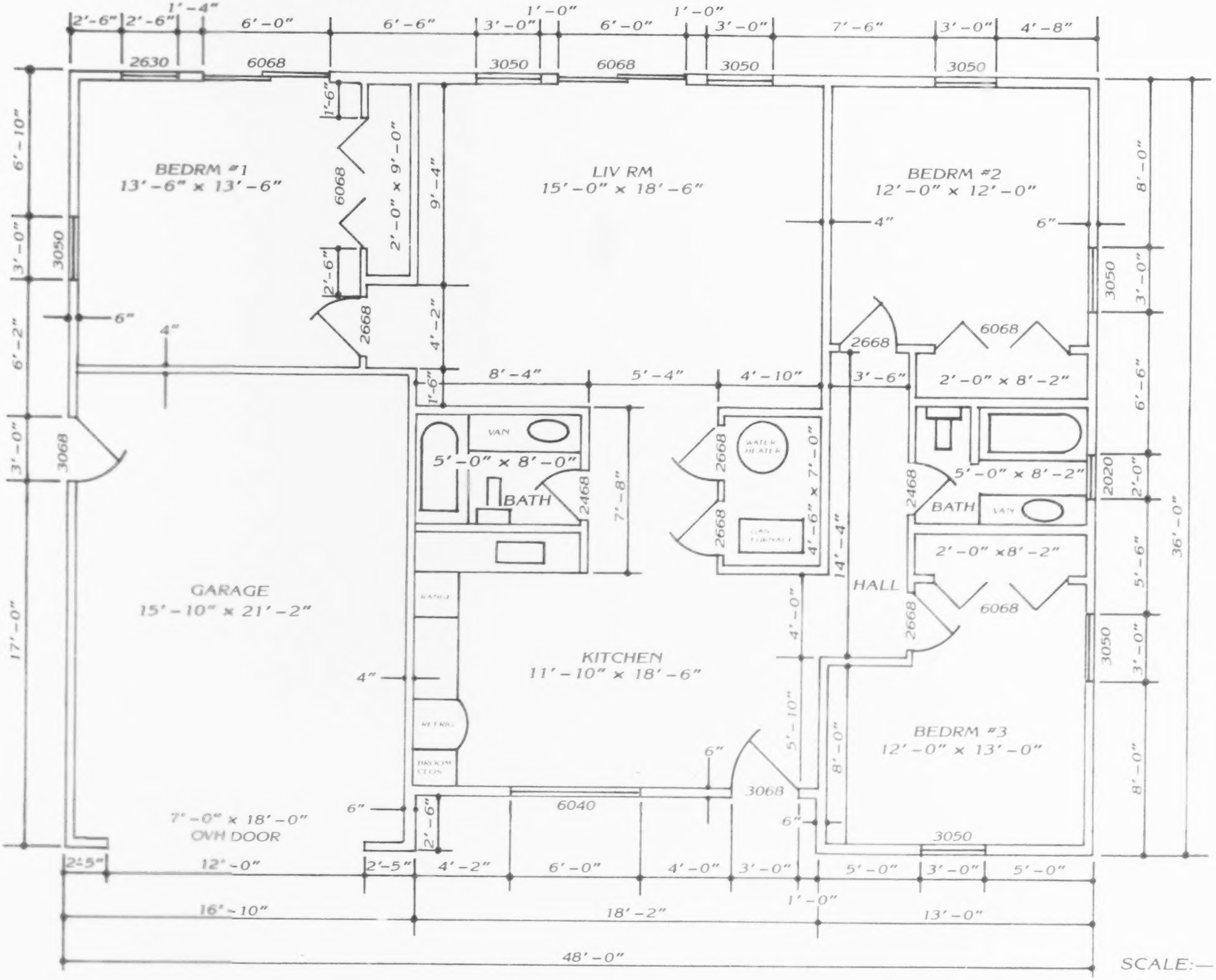
C. Headers (2×12s)______________________________

____

____

D. Diagonal bracing (1×4s, 12 feet long)______________________________

ASSIGNMENT SHEET #2


BEDRM #1
13'-6" × 13'-6"
LIV RM
15'-0" × 18'-6"
BEDRM #2
12'-0" × 12'-0"
GARAGE
15'-10" × 21'-2"
KITCHEN
11'-10" × 18'-6"
BEDRM #3
12'-0" × 13'-0"
BATH
5'-0" × 8'-0"
BATH
5'-0" × 8'-2"
HALL
VAN
WATER HEATER
RANGE
REFRIG
BROOM CLOS
7'-0" × 18'-0"
OVH DOOR
2'-0" × 9'-0"
2'-0" × 8'-2"
2'-0" ×8'-2"
4'-6" × 7'-0"
2630
6068
3050
6068
3050
3050
3050
3068
2668
2468
2020
6040
3068
3050
2'-6"
2'-6"
1'-4"
6'-0"
6'-6"
1'-0"
3'-0"
6'-0"
1'-0"
3'-0"
7'-6"
3'-0"
4'-8"
6'-10"
3'-0"
6'-2"
3'-0"
17'-0"
9'-4"
4'-2"
1'-6"
8'-4"
5'-4"
4'-10"
3'-6"
7'-8"
14'-4"
4'-0"
5'-10"
8'-0"
8'-0"
3'-0"
6'-6"
2'-0"
5'-6"
3'-0"
8'-0"
36'-0"
4"
6"
2'-5"
12'-0"
2'-5"
4'-2"
6'-0"
4'-0"
3'-0"
5'-0"
3'-0"
5'-0"
1'-0"
16'-10"
18'-2"
13'-0"
48'-0"

SCALE:— 3/16" = 1'-0"

WALL AND CEILING FRAMING
UNIT II

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. Width 10′-1″

Height 5′-4″

B. Width 7′-6″

Height 4′-8″

C. Width 7′-0″

Height 4′-2″

D. Width 8′-9″

Height 5′-10″

Assignment Sheet #2

(NOTE: Because estimating answers will vary considerably, answers should be evaluated to the satisfaction of the instructor.)

A. 68

B. 180

C. 12 headers 14 feet long

4 headers 12 feet long

2 headers 10 feet long

D. 8

WALL AND CEILING FRAMING
UNIT II

JOB SHEET #1 — LAY OUT WALL AND PARTITION LOCATIONS ON FLOOR

I. Tools and materials

- A. Chalk line
- B. 100-foot tape
- C. Folding rule or steel tape
- D. Claw hammer
- E. 16d nails
- F. Floor plan
- G. Framing square

II. Procedure

- A. Lay out outside walls
    - 1. Measure in the width of soleplate from the outside edge of the box sill on a wood floor or from the outside of the foundation on a slab floor; mark this distance

      (NOTE: On a wood floor, start a nail at each mark.)
    - 2. Stretch a chalk line between marks and snap line

      (NOTE: If laying off a slab floor, you will need a helper to hold the other end of the line. For a wood floor, fasten the line to the nails.)
        - a. Make sure the line is sufficiently chalked
        - b. Pull the line tight from one end

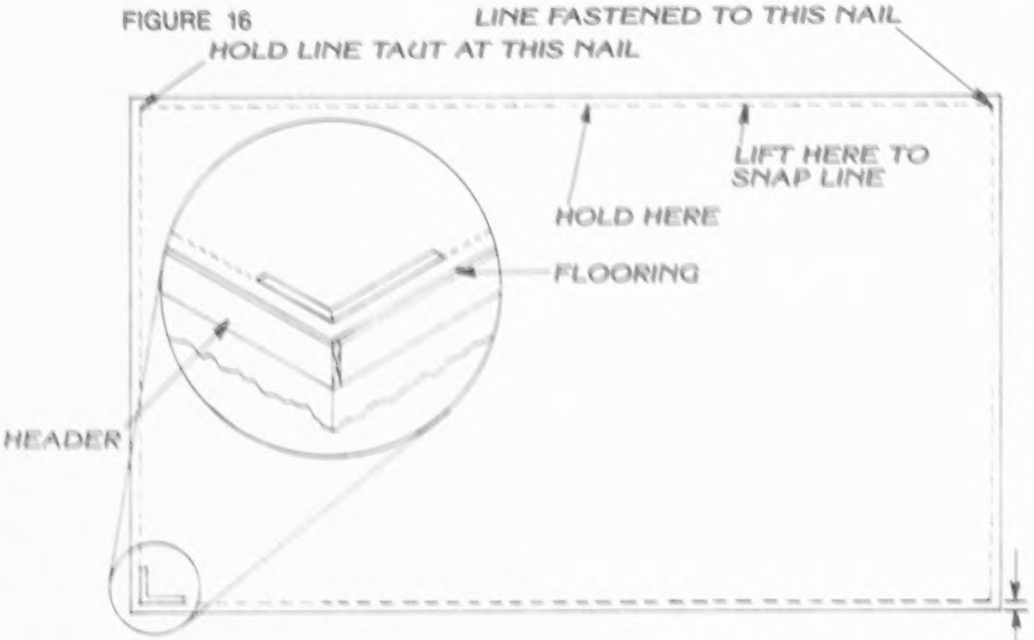
          (NOTE: Have helpers hold each end of the line or fasten it to the nails.)
        - c. Place one thumb on the line approximately in the center
        - d. Hold line firmly to the floor
        - e. Carefully lift one side of the line with the other hand and let it snap to the floor
        - f. Repeat the procedure for the other half of line

          (NOTE: This operation should result in a straight line that represents the inside face of the outside wall soleplate.)

JOB SHEET #1

3. Square off from chalk line to mark other outside walls (Figure 16)

FIGURE 16


LINE FASTENED TO THIS NAIL
HOLD LINE TAUT AT THIS NAIL
LIFT HERE TO SNAP LINE
HOLD HERE
FLOORING
HEADER
WALL THICKNESS

4. Check squareness, using 3-4-5 method

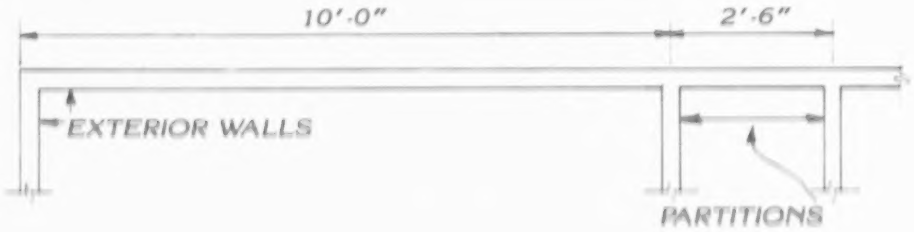
B. Lay out inside walls (Figures 17 and 18)

(NOTE: Lay out all the walls running the length of the building first, then the ones running the width of the building.)

1. Mark one side of each partition on outside walls

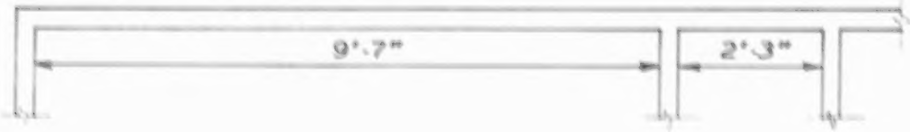
(NOTE: Some floor plans are dimensioned by rooms, and some are dimensioned center to center on partitions.)

FIGURE 17


10'-0"
2'-6"
EXTERIOR WALLS
PARTITIONS

JOB SHEET #1

FIGURE 18



    2. Mark width of soleplate
    3. Square off from exterior wall mark
    4. Stretch chalk line taut along length of partition and snap line
    5. Repeat procedure for other side of wall
    6. Continue steps to mark both sides of all partitions, using other partition marks to square partitions that do not meet exterior wall

C. Clean work area and put away tools and materials

WALL AND CEILING FRAMING
UNIT II

JOB SHEET #2 — CUT STUDS, TRIMMERS, CRIPPLES AND HEADERS TO LENGTH

I. Tools and materials

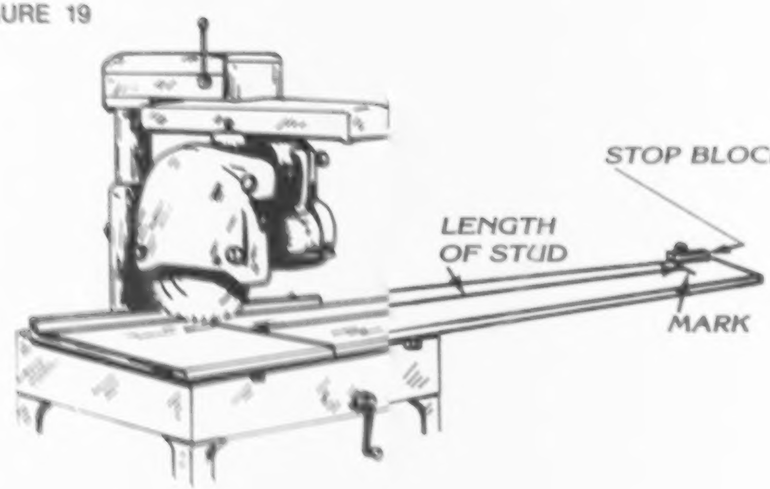
- A. Radial arm saw (with extensions)
- B. Folding rule or steel tape
- C. Claw hammer
- D. C clamp
- E. 16-foot long 2×4s or 2×6s
- F. 16d box nails
- G. 2×12s
- H. ½-inch plywood

II. Procedure

- A. Cut wall studs
  - 1. Determine number needed
  - 2. Determine length of full studs
  - 3. Set up radial arm saw to cut studs
    - a. Measure from the right side of the blade the length of the stud and make a mark on the extension table (See Figure 19)

JOB SHEET #2

FIGURE 19



b. Cut a scrap piece of 2×4 about sixteen inches long

c. Nail or clamp scrap piece to table at mark

(NOTE: Undercut the block slightly.)

4. Cut studs from sixteen-foot material

(NOTE: Studs precut to size can be purchased.)

a. Square right end of stud material

b. Slide material along table until it touches the stop block

CAUTION

Do not bump block so hard that it is moved out of position. Check block occasionally to be sure that it has not moved.

c. Cut first stud

CAUTION

Follow all safety rules concerning the radial arm saw.

d. Check stud for correct length

e. Adjust setup to cut remainder of studs

JOB SHEET #2

        f. Repeat previous steps to cut remainder of studs

        (NOTE: Check every fifteen to twenty studs to be sure they are uniform in length.)

B. Cut trimmer studs

    1. Determine lengths needed

    2. Determine number of each length needed

    3. Set up saw for longest trimmer stud

    4. Cut longest trimmer stud

        (NOTE: Use shortest possible material to cut trimmer studs.)

    5. Repeat procedure for each length of trimmer stud, cutting the next shorter length each time

C. Cut cripple studs

    1. Determine lengths needed

    2. Determine number of each length needed

    3. Set up saw for longest cripple stud

    4. Cut longest cripple stud

        (NOTE: Use shortest possible material to cut cripple studs.)

    5. Repeat procedure for each length of cripple stud, cutting the next shorter length with each cut

D. Cut material for solid headers

    (NOTE: On some jobs, another type of header may be specified.)

    1. Determine lengths needed

    2. Determine number needed for each size opening

        (NOTE: Remember that each header requires two pieces.)

    3. Set up saw to cut headers

        (NOTE: Cut the longest headers first. Plan all your cuts so that waste is held to a minimum.)

    4. Cut headers from 2×12 stock

JOB SHEET #2

5. Repeat entire procedure for each length of header

6. Cut spacers for headers from 1/2-inch CD plywood

   (NOTE: Three spacers are needed for short headers and more for longer headers. Spacers should be cut slightly less than the width of the header and they should be at least 1 1/2 inches wide.)

E. Clean work area and put away tools and materials

WALL AND CEILING FRAMING
UNIT II

JOB SHEET #3 — BUILD CORNERS, Ts, AND HEADERS

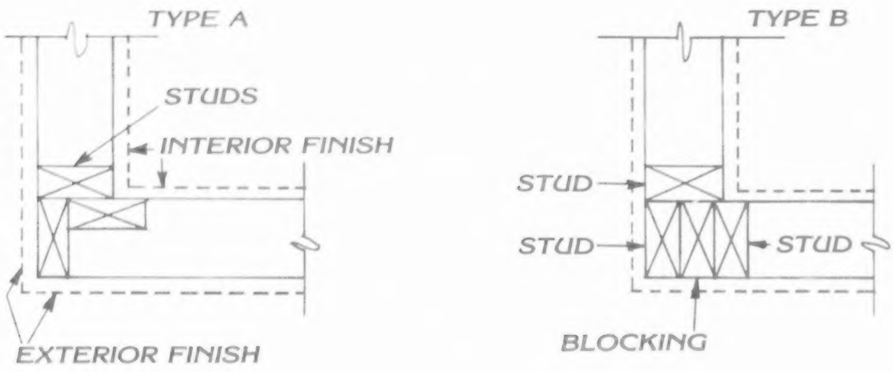
I. Tools and materials

- A. Claw hammer
- B. Power handsaw and extension cord
- C. Folding rule or steel tape
- D. Studs
- E. Stock for blocking
- F. 16d box nails
- G. 2×12 header material cut to length
- H. ½-inch plywood for header spacers

II. Procedure

- A. Construct corners
  1. Determine number of corners needed
  2. Select three of the straightest studs for each corner
  3. Determine type of corner to use (Figure 20)

FIGURE 20


TYPE A
STUDS
INTERIOR FINISH
EXTERIOR FINISH
TYPE B
STUD
STUD
STUD
BLOCKING

JOB SHEET 3

4. Construct Type B corners

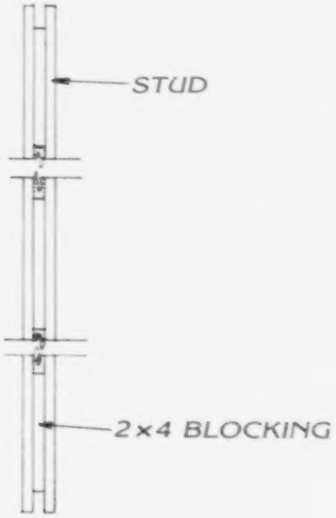
   (NOTE: Type B corners are preferred by most builders.)

   a. Use three blocking pieces 10 to 16 inches long for each corner

      (NOTE: Scrap material may be used for blocking.)

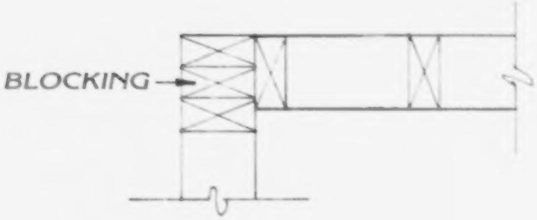
   b. Nail two studs together with blocking between (Figure 21)

FIGURE 21



   c. Attach third stud to end of wall and nail to corner as walls are erected (Figure 22)

FIGURE 22

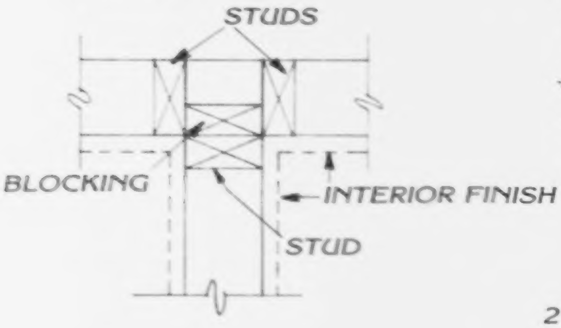


JOB SHEET #3

B. Construct partition Ts

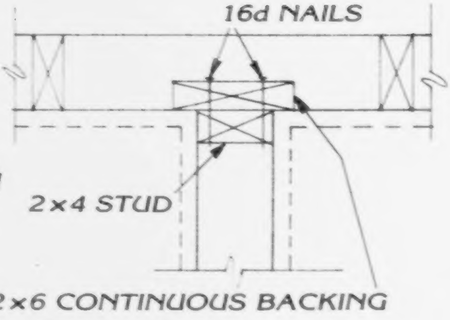
1. Determine the number of Ts needed
2. Determine which type of T to use (Figures 23-25)

FIGURE 23


STUDS
BLOCKING
INTERIOR FINISH
STUD

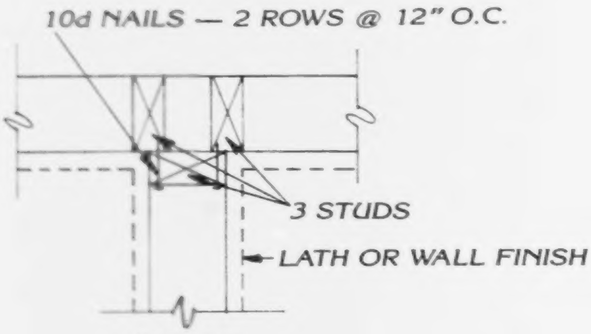
TYPE A

FIGURE 24


16d NAILS
2×4 STUD
2×6 CONTINUOUS BACKING

TYPE B

FIGURE 25


10d NAILS — 2 ROWS @ 12" O.C.
3 STUDS
LATH OR WALL FINISH

TYPE C

3. Determine material needed for type of T to be completed
4. Construct Type A Ts

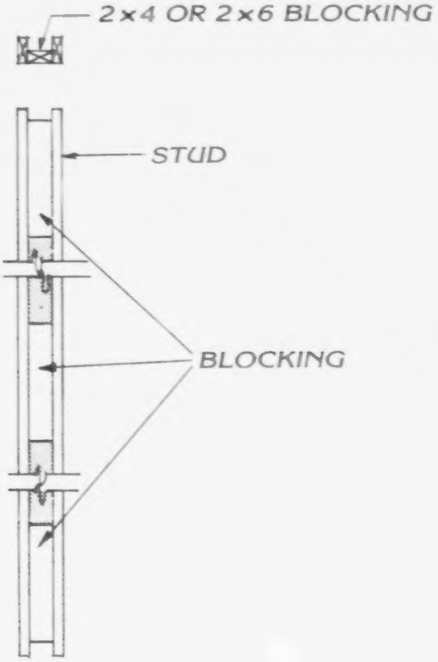
   (NOTE: Type A is preferred by most builders.)

   a. Select three of the straightest studs for each T
   b. Use three blocking pieces 10 to 16 inches long for each T

JOB SHEET 3

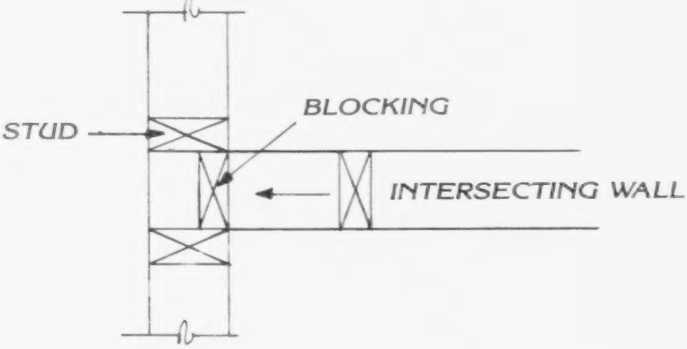
c. Nail two studs together with blocking between (Figure 26)

FIGURE 26


2×4 OR 2×6 BLOCKING
STUD
BLOCKING

d. Attach third stud to the end of the intersecting wall and nail to blocking as walls are erected (Figure 27)

FIGURE 27

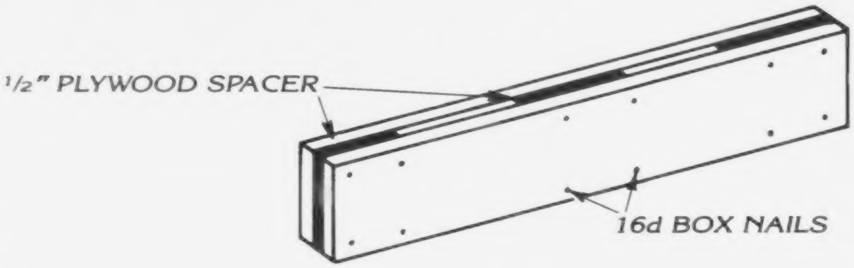

BLOCKING
STUD
INTERSECTING WALL

JOB SHEET #3

C. Construct solid headers

1. Arrange plywood spacers 16 to 24 inches apart along one 2×12
2. Place second 2×12 on top of spacers with edges even with first 2×12
3. Hold second 2×12 in place and drive nails into it (Figure 28)

FIGURE 28



D. Cut rough sills

1. Determine lengths of rough sills by subtracting thickness of two studs from each window header length
2. Cut one rough sill for each window

   (NOTE: Some very heavy windows may require an extra sill.)

E. Clean work area and put away tools and materials

WALL AND CEILING FRAMING
UNIT II

JOB SHEET #4 — CONSTRUCT WALL SECTIONS FOR A SINGLE-STORY STRUCTURE

I. Tools and materials

- A. Folding rule or steel tape
- B. Claw hammer
- C. Framing square
- D. Power handsaw and extension cord
- E. 4-foot level
- F. 100-foot tape marked 16 inches on center
- G. 16d and 8d nails
- H. Regular studs
- I. Corners
- J. Ts for partitions
- K. Headers
- L. 16-foot-long plate material
- M. Cripple studs
- N. Trimmer studs
- O. Brace material, 12-foot-long 1×4s or 4×8 plywood

II. Procedure

- A. Plan sequence for raising walls
- B. Select material from sixteen-foot stock for plates

  (NOTE: Crooked material may be used for soleplates since they can easily be straightened. Straight stock should be saved for top plates.)

JOB SHEET #4

C. Cut soleplate and top plate for first wall to length and tack to floor side by side with ends flush (Figure 29)

(NOTE: Some carpenters prefer to tack plates together face to face and lay out studs on the edges of the plates.)

FIGURE 29

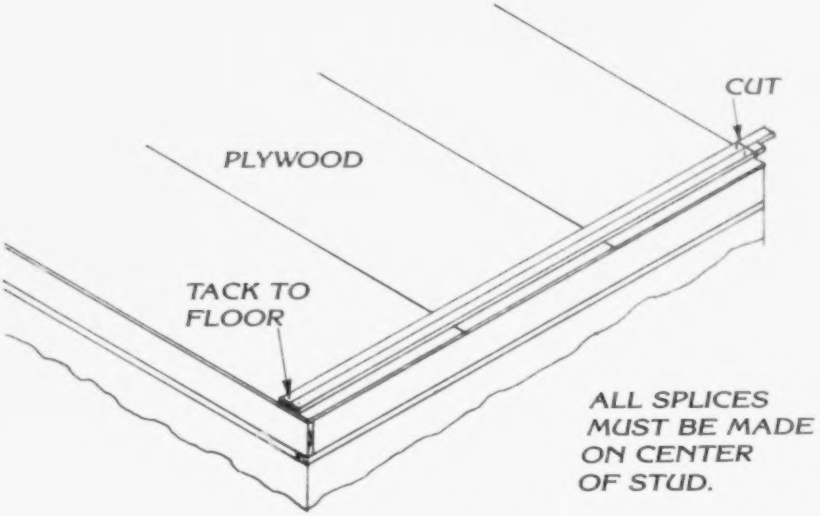

CUT
PLYWOOD
TACK TO FLOOR
ALL SPLICES MUST BE MADE ON CENTER OF STUD.

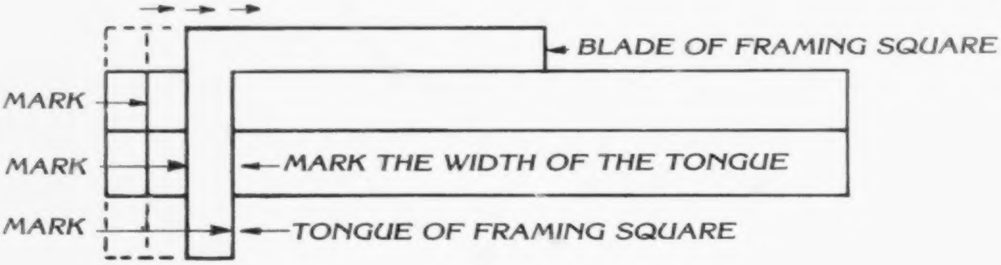
PLATE LAID OUT ON SUBFLOOR

D. Lay off stud locations on plates, side walls first

(NOTE: Lay off all walls from left to right.)

1. Mark plates for corner (Figure 30)

FIGURE 30


BLADE OF FRAMING SQUARE
MARK
MARK
MARK THE WIDTH OF THE TONGUE
MARK
TONGUE OF FRAMING SQUARE

JOB SHEET #4

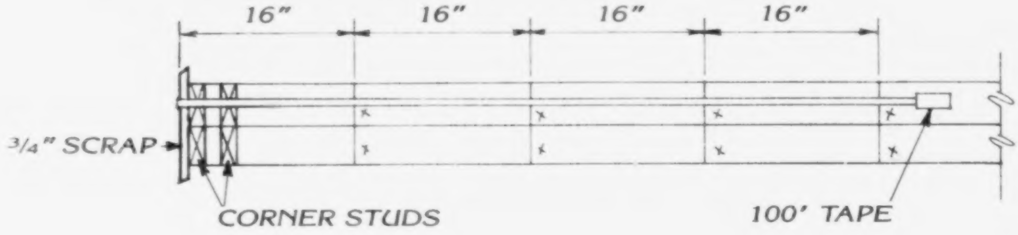
2. Use 100-foot tape to lay off all stud locations

   a. Place scrap of 3/4-inch material at left end of plates

   b. Hook end of tape over scrap piece and make a mark on the plates at stud intervals along tape

   c. Place a small "X" at the right of each mark (Figure 31)

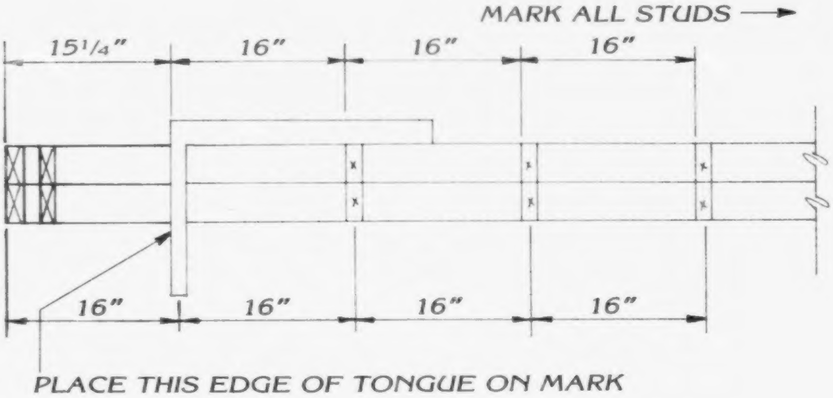
FIGURE 31


16"
16"
16"
16"
3/4" SCRAP
CORNER STUDS
100' TAPE

   d. Use framing square to mark stud locations across both plates (Figure 32)

   (NOTE: Splices in the plate must fall at center of stud.)

FIGURE 32

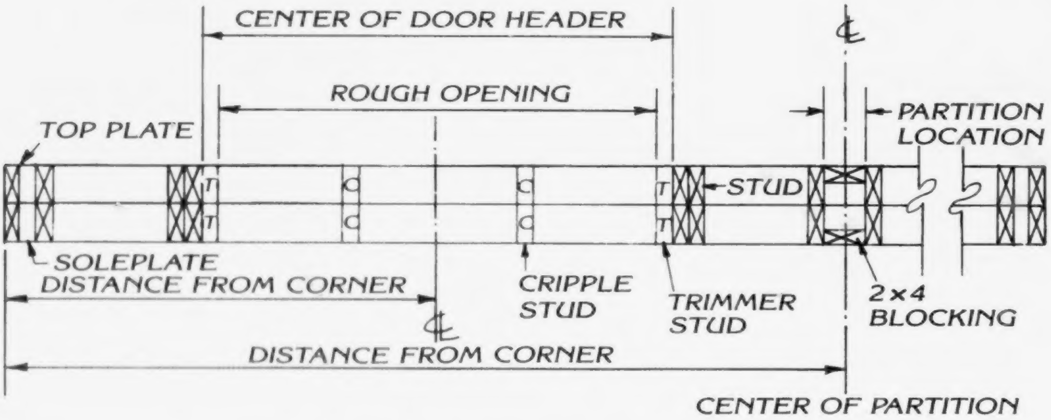

MARK ALL STUDS →
15 1/4"
16"
16"
16"
16"
16"
16"
16"
PLACE THIS EDGE OF TONGUE ON MARK

JOB SHEET #4

3. Locate center of openings and lay off trimmer stud locations
    a. Determine distance from end of plate to center of opening from plan
    b. Measure required distance and mark on plate
    c. Measure and mark one-half of header length on each side of center of opening

       (NOTE: This locates outside of each trimmer stud.)
    d. Mark trimmer stud locations with a "T" and cripple studs with a "C"
4. Locate and mark positions on the plates with the style partition T you plan to use (Figure 33)

FIGURE 33


CENTER OF DOOR HEADER
ROUGH OPENING
℄
PARTITION LOCATION
TOP PLATE
T
C
STUD
SOLEPLATE
DISTANCE FROM CORNER
CRIPPLE STUD
TRIMMER STUD
2×4 BLOCKING
℄
DISTANCE FROM CORNER
CENTER OF PARTITION

5. Lay off other walls, using same procedure

   (NOTE: Remember that end walls will fit between side walls; therefore, the plates will be shorter than the outside wall dimensions by the width of two plates.)
6. Remove nails from plates

E. Assemble wall sections

1. Turn plates on edge with marks facing each other

   (NOTE: Build wall with inside of wall facing down.)
2. Place soleplate at edge of floor
3. Move top plate approximately nine feet toward center of structure
4. Lay studs at each "X" mark

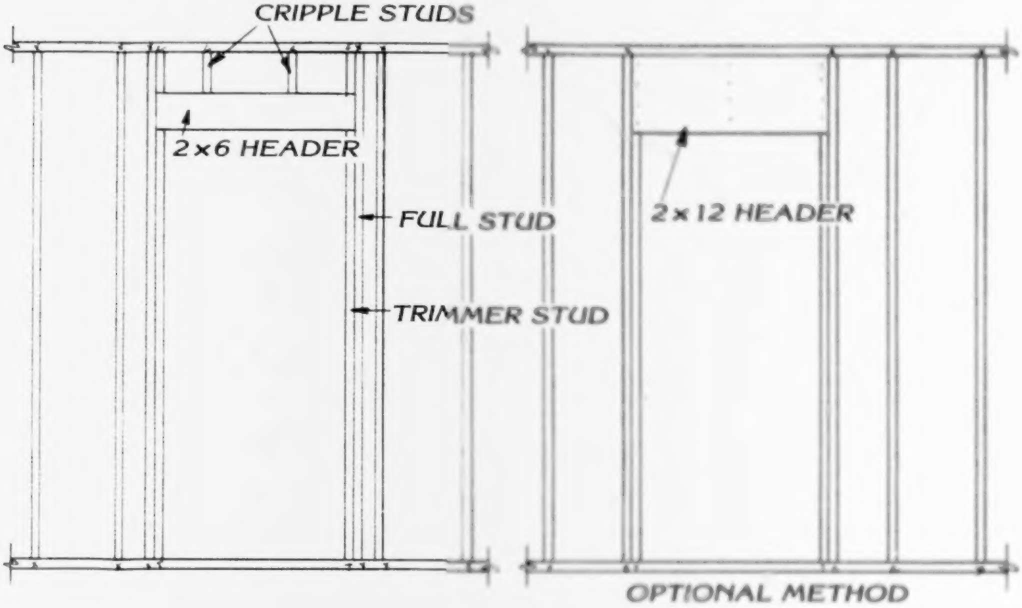
   (NOTE: If studs are crooked, turn so that crown is up.)

JOB SHEET #4

5. Place appropriate size headers in place
6. Place trimmer studs at each spot marked with a "T"

   (NOTE: Trimmer studs and headers may be assembled prior to wall assembly; see Figure 34.)

FIGURE 34


CRIPPLE STUDS
2×6 HEADER
FULL STUD
TRIMMER STUD
2×12 HEADER
OPTIONAL METHOD

7. Place rough sills and cripple studs where openings are located

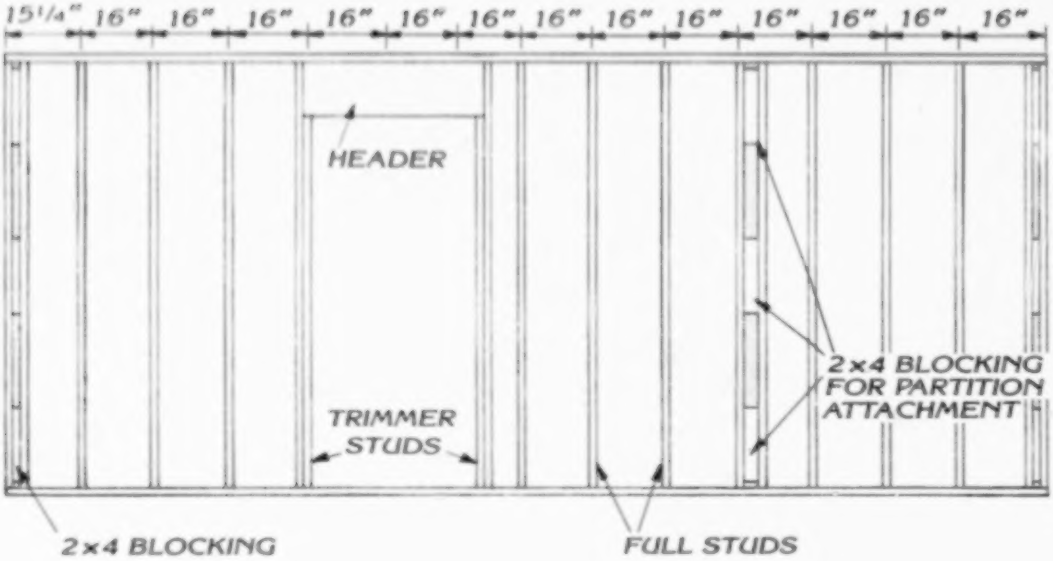
F. Nail framework together

1. Drive two 16d nails through the plate into end of each 2×4 stud; use three nails for 2×6 studs
2. Install headers and trimmers or opening assemblies, making sure that openings are framed square and level
3. Nail cripple studs in place and install rough sills where needed

JOB SHEET #4

4. Finish nailing framework together (Figure 35)

FIGURE 35


15¼"
16"
16"
16"
16"
16"
16"
16"
16"
16"
16"
16"
16"
16"
HEADER
TRIMMER STUDS
2×4 BLOCKING FOR PARTITION ATTACHMENT
2×4 BLOCKING
FULL STUDS

(NOTE: Soleplates at door openings may be cut out at any convenient time during the layout or construction process.)

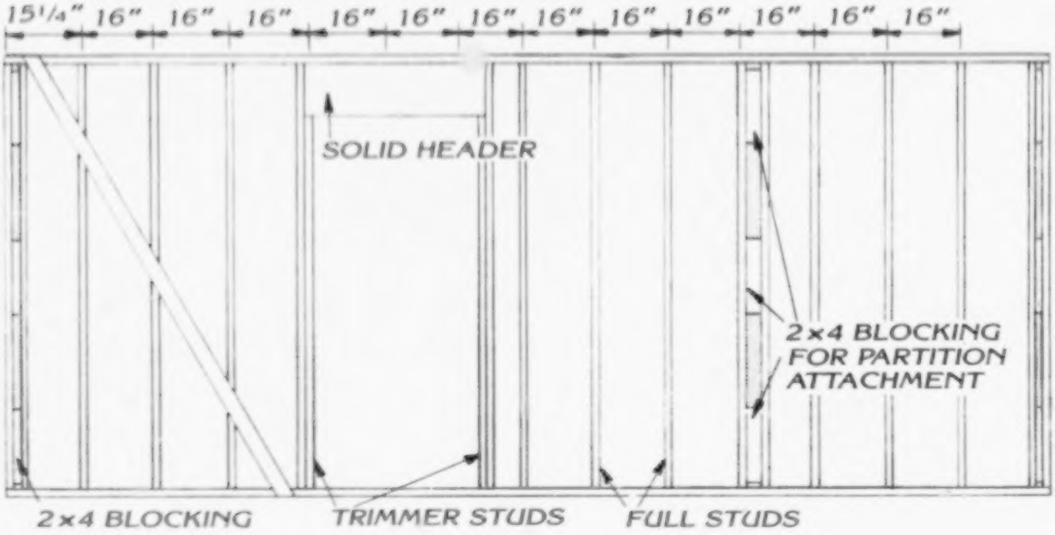
G. Install permanent bracing

(NOTE: Diagonal lumber or plywood corners do not need any additional bracing).

1. Lay 1×4×12-foot bracing against studs with left end near top of corner stud and right end against soleplate
2. Mark each side of brace on each stud
3. Saw out sections for brace on each stud
4. Temporarily nail top left-hand corner of brace to corner
5. Square framework
6. Temporarily nail brace to soleplate (See Figure 36)

JOB SHEET #4

FIGURE 36


15¼"
16"
16"
16"
16"
16"
16"
16"
16"
16"
16"
16"
16"
SOLID HEADER
2×4 BLOCKING FOR PARTITION ATTACHMENT
2×4 BLOCKING
TRIMMER STUDS
FULL STUDS

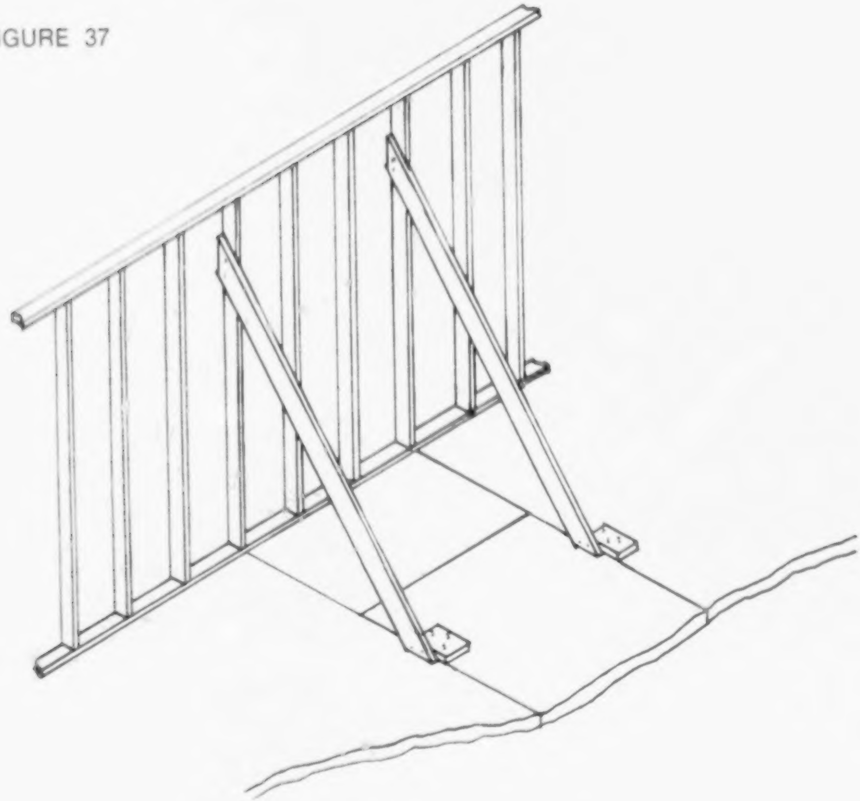
H. Raise wall section and nail in place

1. On wood floors, use two 16d nails in every other floor joist
2. On concrete slabs, use concrete nails, powder-actuated tool and pins, or preset anchor bolts
3. Attach temporary bracing (See Figure 37)

   (NOTE: Be sure bracing does not protrude through exterior of wall.)

JOB SHEET #4

FIGURE 37



I. Construct remainder of wall section following same procedure; raise and nail in place

J. Replumb corners

K. Nail corners together using 16d nails

L. Check that corners are plumb and square; nail bracing in place

  1. Completely drive nails in top plate and soleplate

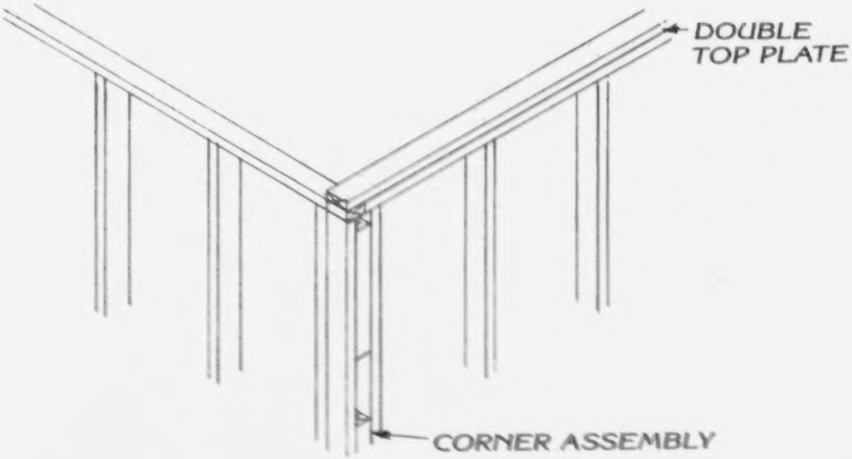
  2. Drive nail through bracing into each stud

JOB SHEET #4

M. Lay out double top plate

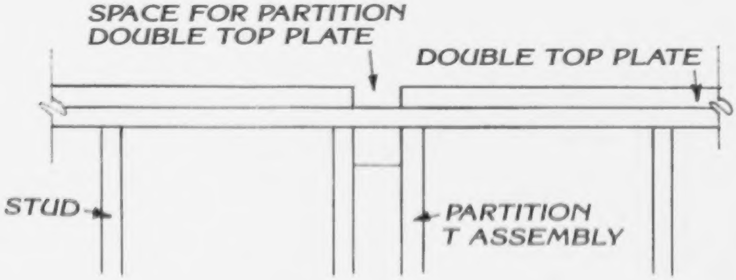
1. Begin at corner and lay out double top plate along end wall first (Figure 38)

FIGURE 38


DOUBLE TOP PLATE
CORNER ASSEMBLY

2. Cut double top plate on exterior walls to accept double plate on partitions (Figure 39)

FIGURE 39

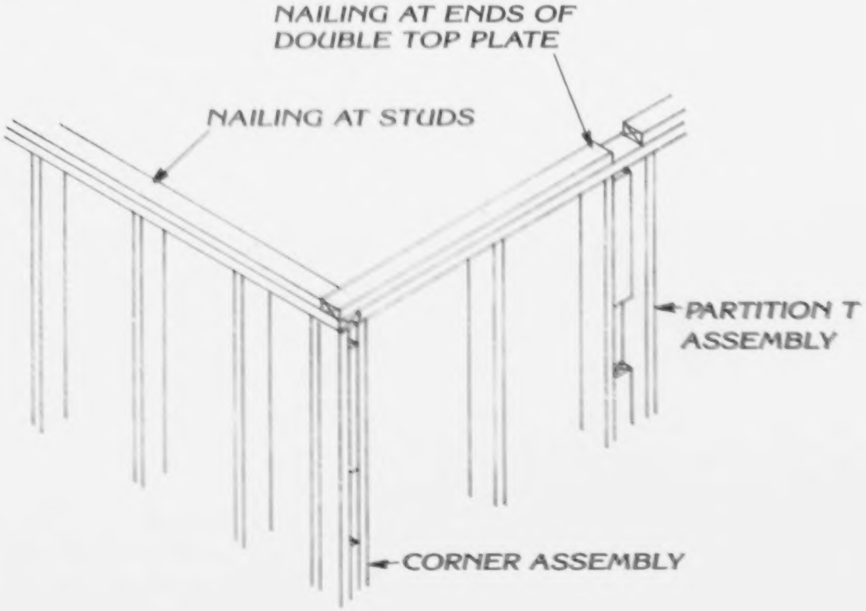

SPACE FOR PARTITION DOUBLE TOP PLATE
DOUBLE TOP PLATE
STUD
PARTITION T ASSEMBLY

JOB SHEET #4

N. Install double top plate (Figure 40)

1. Drive two 16d nails at the end of each double top plate section
2. Drive one 16d nail on each side of stud locations on opposite sides of double top plate

FIGURE 40


NAILING AT ENDS OF DOUBLE TOP PLATE
NAILING AT STUDS
PARTITION T ASSEMBLY
CORNER ASSEMBLY

O. Construct and install interior walls following same procedures

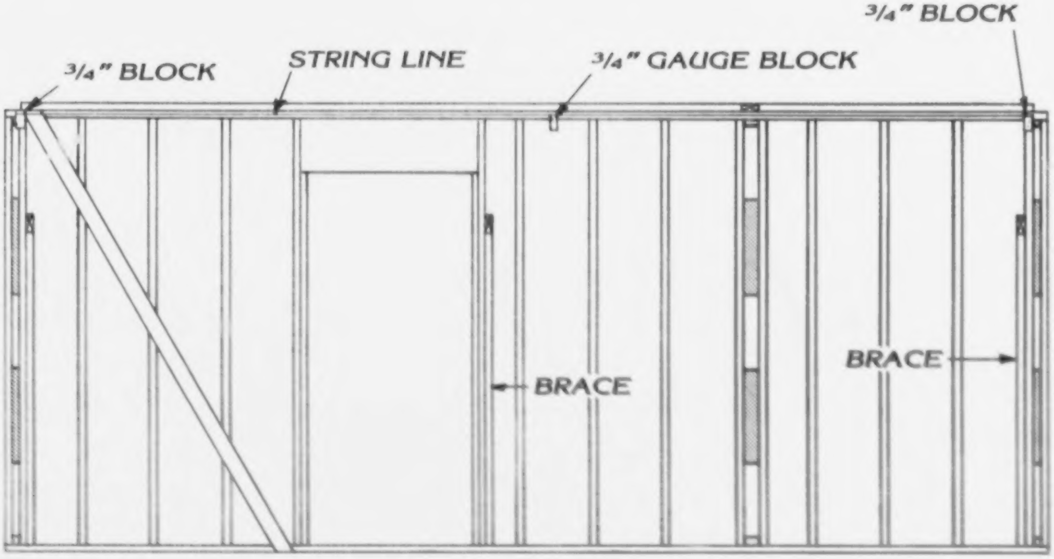
P. Install interior double top plates and tie to exterior walls

Q. Straighten walls and adjust bracing (See Figure 41)

1. Nail ¾-inch block on each corner at top of walls
2. String line from one corner to opposite corner
3. Stretch line very tight so there is no sag
4. Use ¾-inch gauge block to check wall line
5. Adjust bracing as you check the wall

JOB SHEET #4

FIGURE 41


3/4" BLOCK
STRING LINE
3/4" GAUGE BLOCK
3/4" BLOCK
BRACE
BRACE

R. Clean work area and put away tools and materials

WALL AND CEILING FRAMING
UNIT II

JOB SHEET #5 — LAY OUT AND INSTALL CEILING JOISTS

I. Tools and materials

  A. 100-foot tape with markings at 16-inch centers

  B. Folding rule or steel tape

  C. Claw hammer

  D. Power handsaw and extension cord

  E. Framing square

  F. Joists, lengths and sizes as specified

  G. 16d box nails

II. Procedure

(NOTE: Ceiling joists are normally installed after the walls are erected and before the roof is framed. However, in laying out and installing ceiling joists, the roof design must be considered. Your instructor may choose to teach this procedure after you have studied Unit III, "Roof Framing.")

  A. Lay out joist locations on double top plate

    1. For a gable roof

      a. Determine the direction joists will run (usually the width of the structure)

      b. Locate the outside of the first joist flush with the outside corner of the double top plate

      c. Hold the zero end of the 100-foot tape ¾-inch past the inside of the end double plate and proceed to mark sixteen-inch intervals on face of the plate, moving from left to right

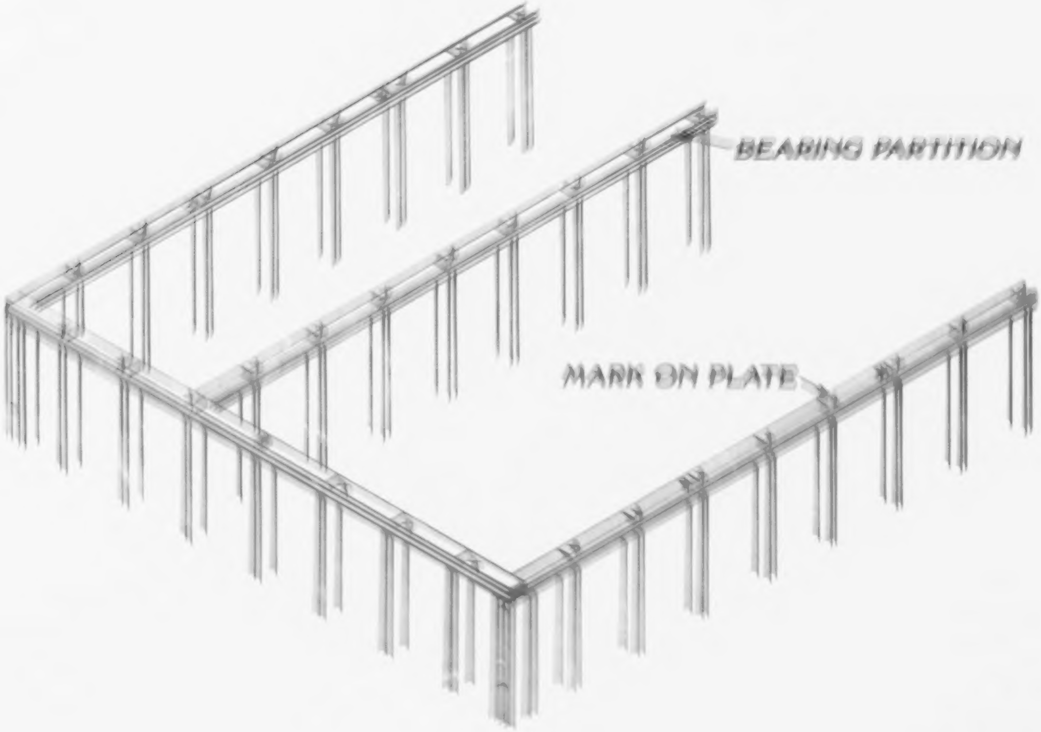
      d. Place an "X" to the right of each mark for joist and an "R" on the left of every third mark for rafters set on two-foot centers

      (NOTE: The "X" designates the side of the mark on which joist is placed. The "R" designates the side of the mark on which the rafter is placed.)

JOB SHEET #5

e. Repeat steps b through d on the opposite wall or bearing partition, reversing the procedure of measurement, going from right to left (Figure 42)

FIGURE 42



2. For a hip roof
   a. Determine the direction joists will run (usually the width of the structure)

   b. Determine length of run and transfer this measurement to the double top plate

   c. Hold the zero end of the 100-foot tape $\frac{3}{4}$-inch past the first joist location and mark sixteen-inch intervals on the plate, moving from left to right

   d. Place an "X" to the right of each mark

      (NOTE: The "X" designates the side of the mark on which the joist is placed.)

JOB SHEET #5

e. Repeat steps c and d on the opposite wall and bearing partition, reversing the procedure of measurement, going from right to left

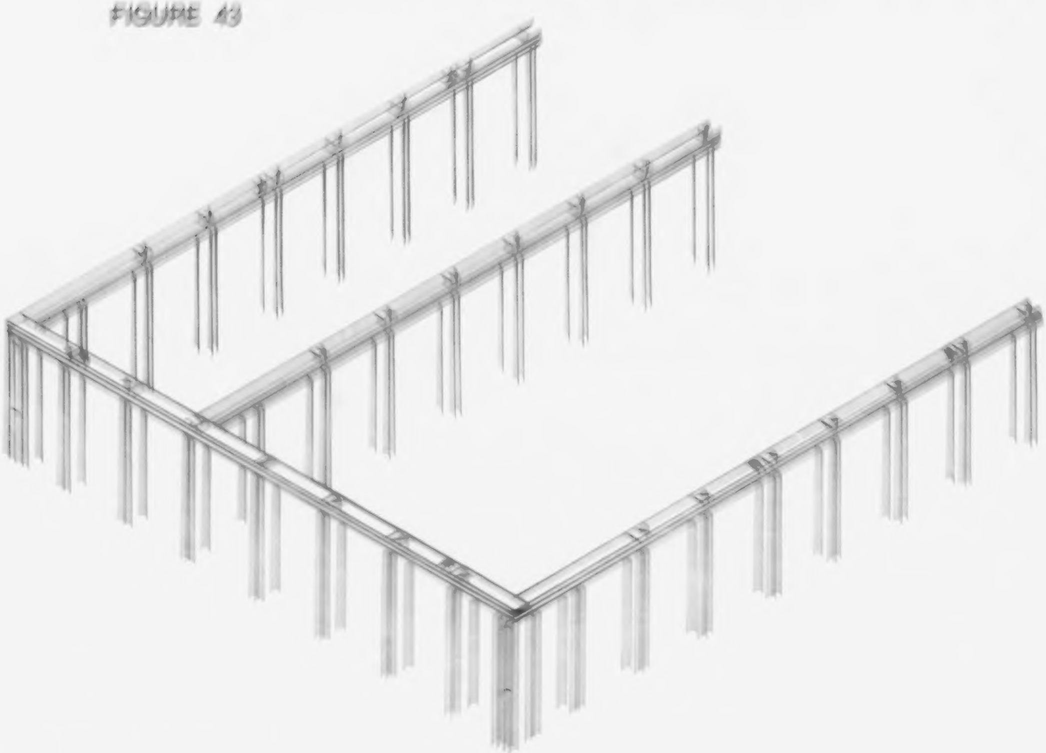
f. Establish center of end wall and mark

g. Hold zero end of the tape ¾-inch past the center mark and mark sixteen-inch intervals on the plate, moving from left to right

h. Place an "X" to the right of each mark

i. Repeat steps g and h on opposite end, reversing the procedure of measurement, going from right to left (Figure 43)

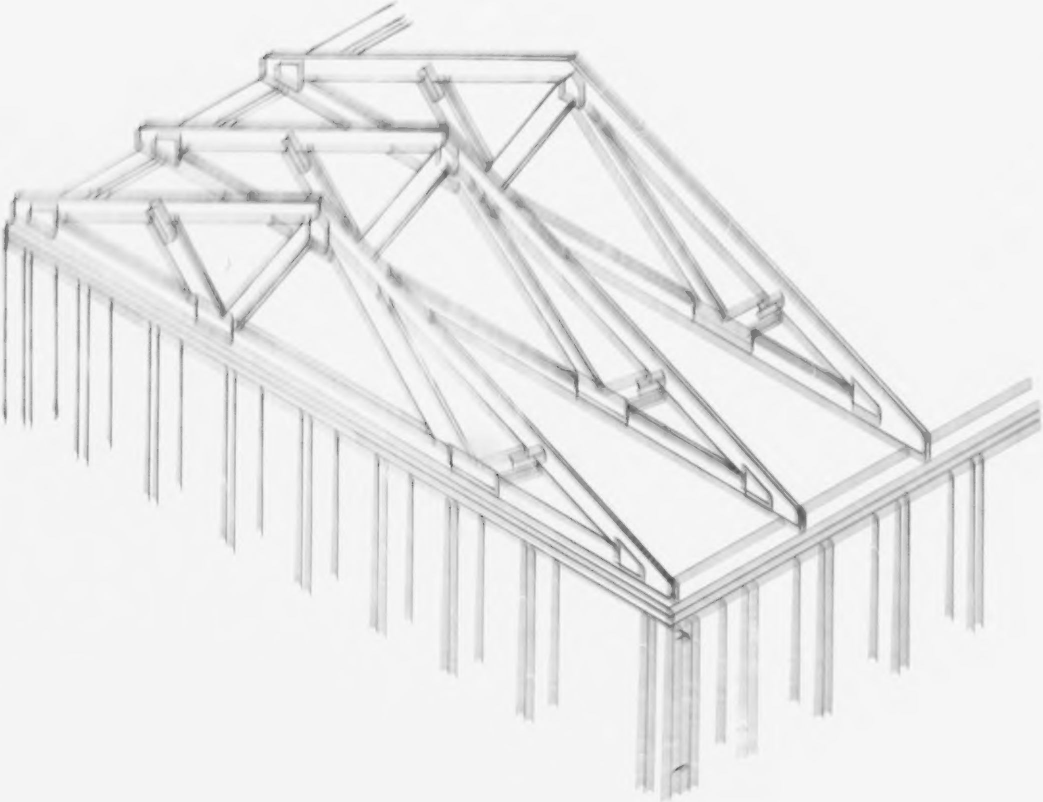
FIGURE 43



JOB SHEET #5

(NOTE: When roof trusses are used, the ceiling joists are eliminated. Roof trusses can usually be spaced on 2-foot centers; see Figure 44.)

FIGURE 44

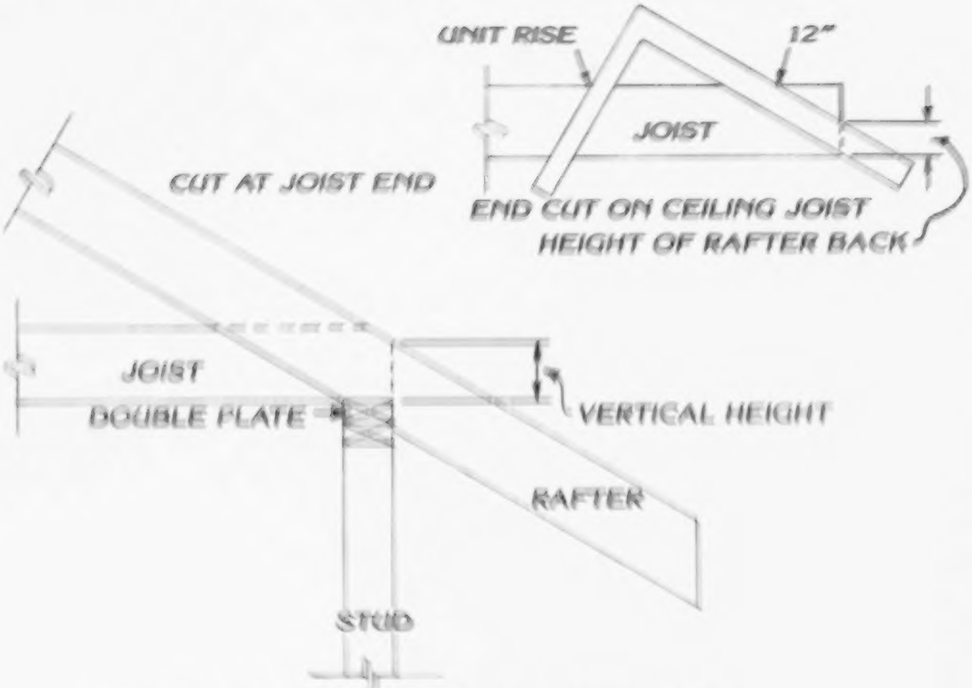


B. Install ceiling joist

1. Cut joist ends to the pitch of the roof (See Figure 45)

JOB SHEET #5

FIGURE 45


UNIT RISE
12"
JOIST
CUT AT JOIST END
END CUT ON CEILING JOIST
HEIGHT OF RAFTER BACK
JOIST
DOUBLE PLATE
VERTICAL HEIGHT
RAFTER
STUD

HEIGHT OF BACK OF RAFTER ABOVE PLATE

2. Place one joist, crown up, on each mark that was made on the plate
3. Splice joists on bearing walls (See Figures 46 and 47)

   (NOTE: There should be a maximum overlap of 6 inches.)

JOB SHEET #5

FIGURE 46

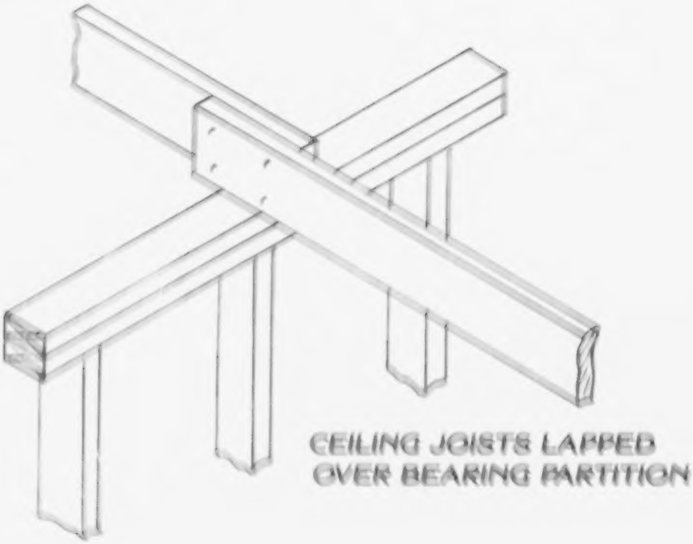
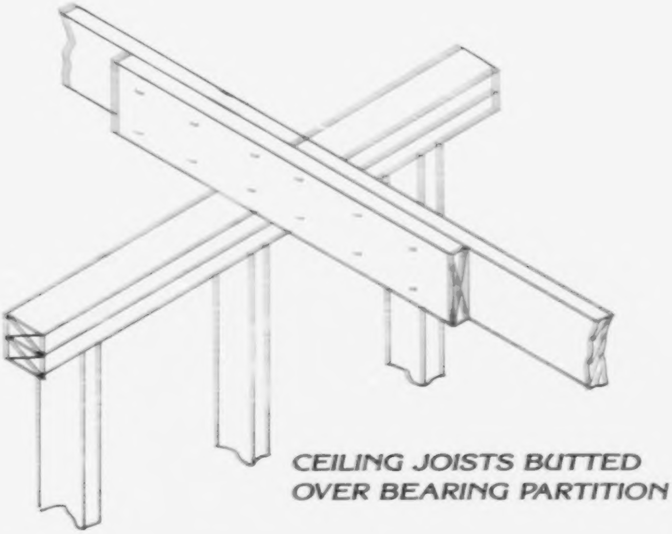

CEILING JOISTS LAPPED
OVER BEARING PARTITION

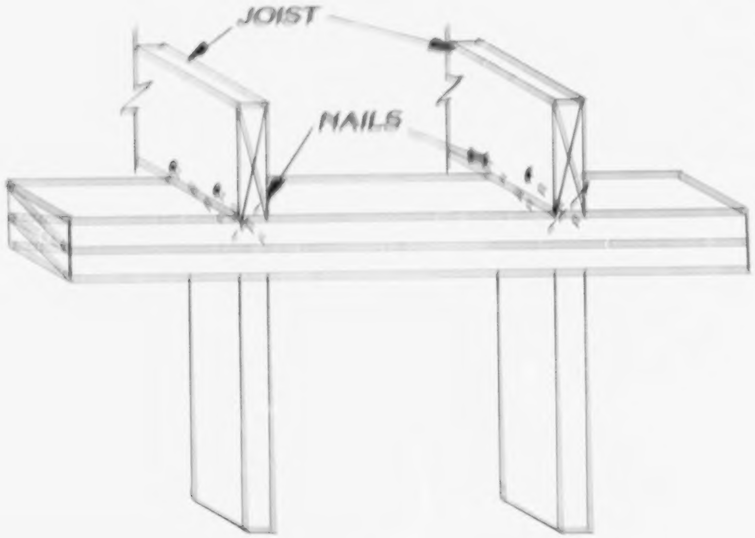
FIGURE 47


CEILING JOISTS BUTTED
OVER BEARING PARTITION

JOB SHEET #5

4. Toenail joist to plate with three 16d box nails (Figure 48)

FIGURE 48



C. Clean work area and put away tools and materials

WALL AND CEILING FRAMING
UNIT II

TEST

NAME ____ SCORE ________________

1. *Match terms associated with wall and ceiling framing to their correct definitions. Write the correct numbers in the blanks.*

_____a. Top and sides of a door or window frame that contacts the door or window sash; consists of a head jamb and side jambs

_____b. Lowest horizontal member of a wall or partition to which the studs are nailed; rests on the rough floor

_____c. Horizontal structural member that supports the load over an opening, such as a window or door

_____d. Triangular portion of exterior wall above the eaves at the end at a structure

_____e. Partition wall that supports the structure above

_____f. Wood block used as filler piece and support between framing members

_____g. Any part of a framing stud that is cut less than full size, as over a door, window, or under a window opening

_____h. Main vertical framing member in walls and partitions

_____i. Upper horizontal structural member of a wall used to carry the rafters or trusses of a roof

_____j. Top plate made of two members to allow better stiffening of the wall and for tying together splices, corners, and partitions that are at right angles to a wall

1. Header
2. Top plate
3. Blocking (spacer)
4. Stud
5. Bearing wall
6. Rough opening
7. Gable
8. Double top plate
9. Soleplate
10. Partition
11. Rough sill
12. Trimmer
13. Bearing partition
14. Jamb
15. Cripple stud

TEST

______k. Opening in framing formed by framing members, such as for windows and doors

______l. Wall that subdivides space within a building

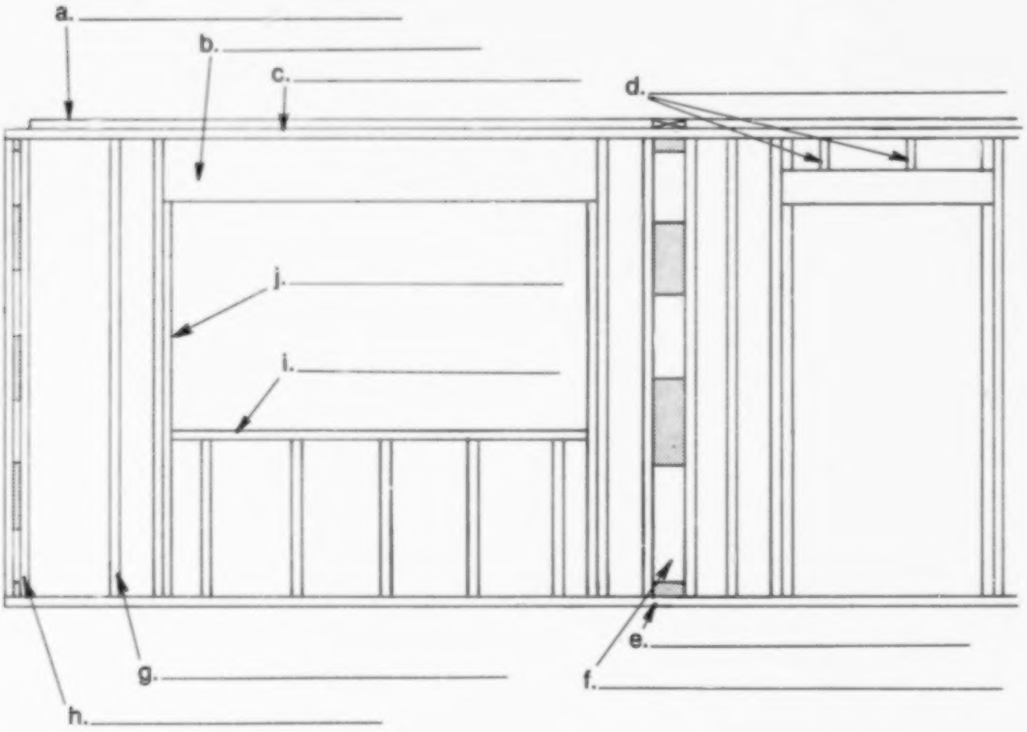
______m. Vertical framing member that forms the sides of rough openings for doors and windows and on which the header rests

______n. Wall that supports the floors and roof directly above it in addition to its own weight

______o. Lower framing member attached to the top of the bottom cripple studs to form the base of a rough opening for a window

2. Identify the framing members in the following illustration. Write the correct names in the blanks.

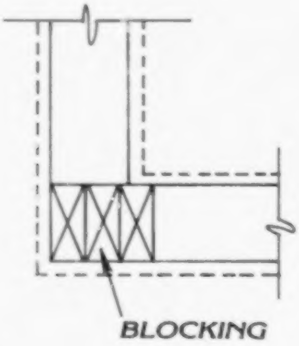
Corner assembly
Cripple studs
Rough sill
Partition wall assembly
Double top plate
Regular stud
Soleplate
Header
Trimmer stud
Top plate



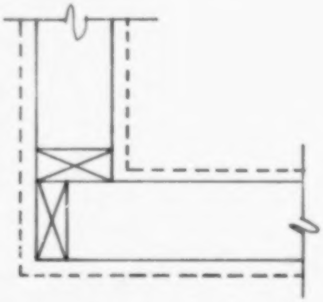
TEST

3. Complete drawings of common methods used to construct outside corners of wall frames. Draw in the missing member in each illustration below.

   a. Constructed with three full studs and blocking

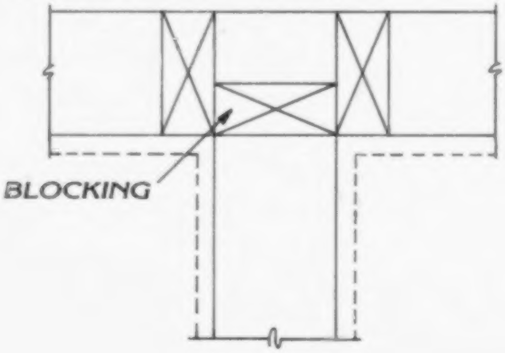


   b. Constructed with three full studs (no blocking)

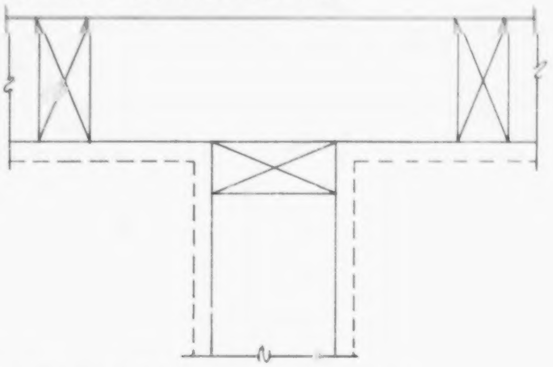


4. Complete drawings of common methods used to construct partition Ts. Draw in the missing member in each of the following illustrations.

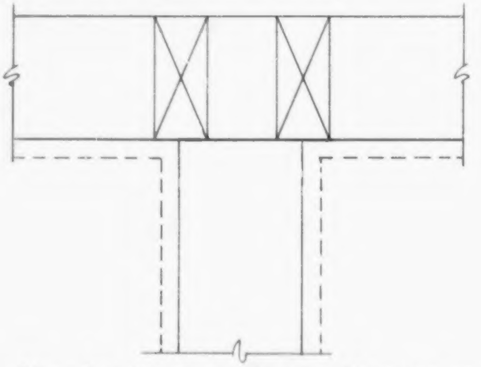
   a. Constructed with three studs and blocking



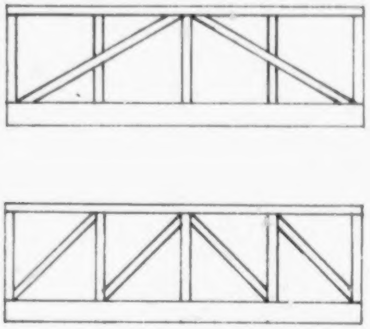
b. Constructed with a continuous backer

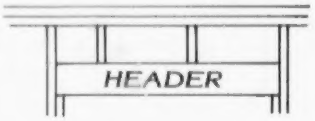


c. Constructed with three studs (no blocking)



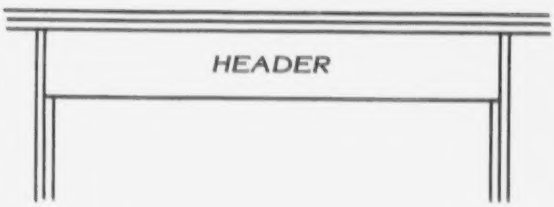
5. Label the types of headers illustrated below. Write the correct names in the blanks.

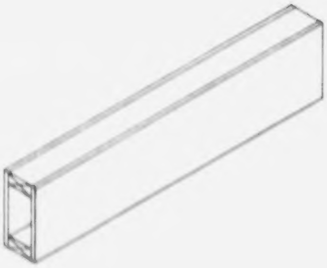




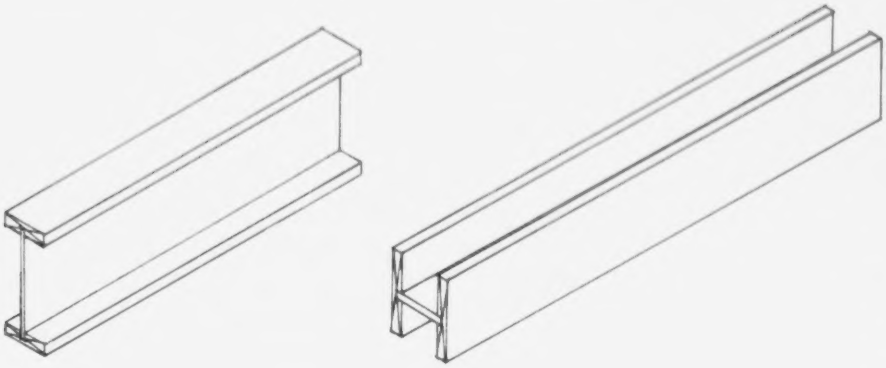
a. ______________________________ b. ______________________________

TEST





c. ______________________ d. ______________________



e. ______________________

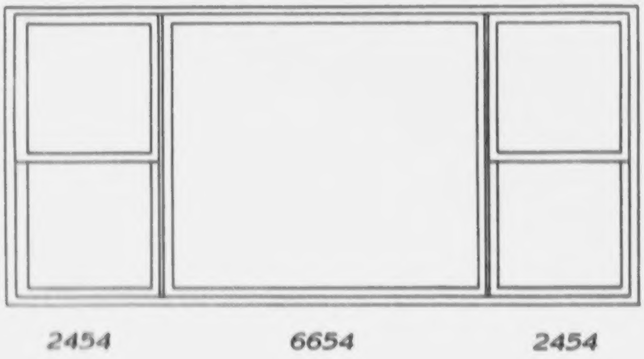
6. Compute the length of a regular stud for a finished ceiling height of 8′-½″ on a conventional wood floor with ½-inch drywall ceiling.

Regular stud length ______________________________

TEST

7. Compute rough opening (R.O.) dimensions for the combination window units illustrated.

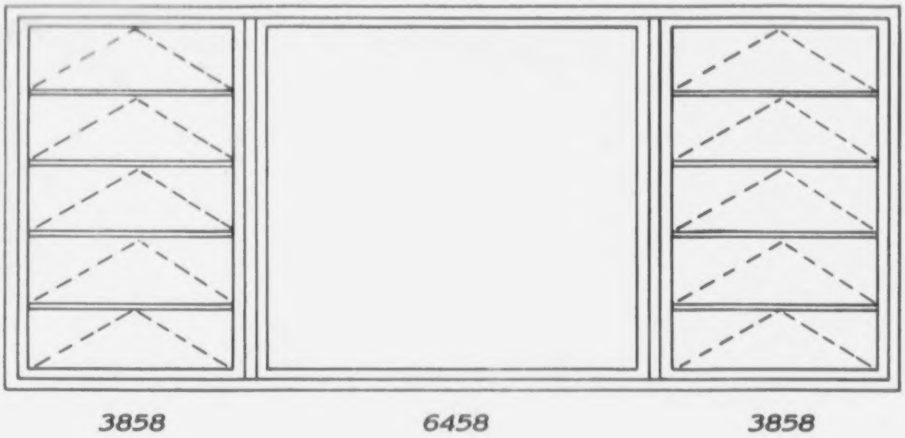
   a. Double hung and fixed


2454
6654
2454

2 mullions ($1\frac{1}{4}$" each)

Total rough opening ____________________

   b. Awning and fixed


3858
6458
3858

2 mullions ($1\frac{1}{2}$" each)

Total rough opening ____________________

TEST

8. Compute rough opening (R.O.) dimensions for the doors listed below.

   a. 2′-8″×6′-8″

   Actual rough opening size______________________________

   b. 3′-0″×6′-8″

   Actual rough opening size______________________________

   c. 3′-6″×7′-0″

   Actual rough opening size______________________________

9. Compute the length of trimmers for a standard 6′-8″ door opening on a slab floor. Show your work.

   Length of trimmers______________________________

10. Compute the length of the headers for a window 2′-8″ wide by 4′-0″ high.

   Length of headers______________________________

TEST

11. Select from the following list construction details that should be added during wall framing. Write an "X" in the blank before each correct answer.

_____a. Supports for towel bars

_____b. Framing for pocket-type sliding doors

_____c. Supports for television antennas

_____d. Rough opening for dryer vent

_____e. Backings for various appliances

_____f. Rough opening for air conditioners

_____g. Openings for heating ducts

_____h. Corner blocks for nailing base

_____i. Backing for hanging picture frames

_____j. Supports for plumbing fixtures

_____k. Framing for recessed cabinets and electrical panels

_____l. Rough opening for gas furnace

_____m. Rough openings for air ducts, exhaust fans, and disappearing stair units

_____n. Framing for chimney and fireplace

_____o. Rough openings for stairwells

12. List methods used to brace walls.

a. Permanent bracing

1) ____

2) ____

3) ____

b. Temporary bracing

1) ____

2) ____

13. Select from the following list pennyweights of nails most often used in framing. Write an "X" in the blank before the four most commonly used sizes.

_____a. 4d

_____b. 6d

_____c. 8d

_____d. 10d

_____e. 12d

_____f. 16d

_____g. 20d

_____h. 30d

TEST

14. Estimate the amount of framing material needed for the floor plan illustrated on the next page. Write the correct amounts of materials in the blanks.

a. Studs, 16" on center________________________________

b. Plates____

(NOTE: Test question 15 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

15. Demonstrate the ability to:

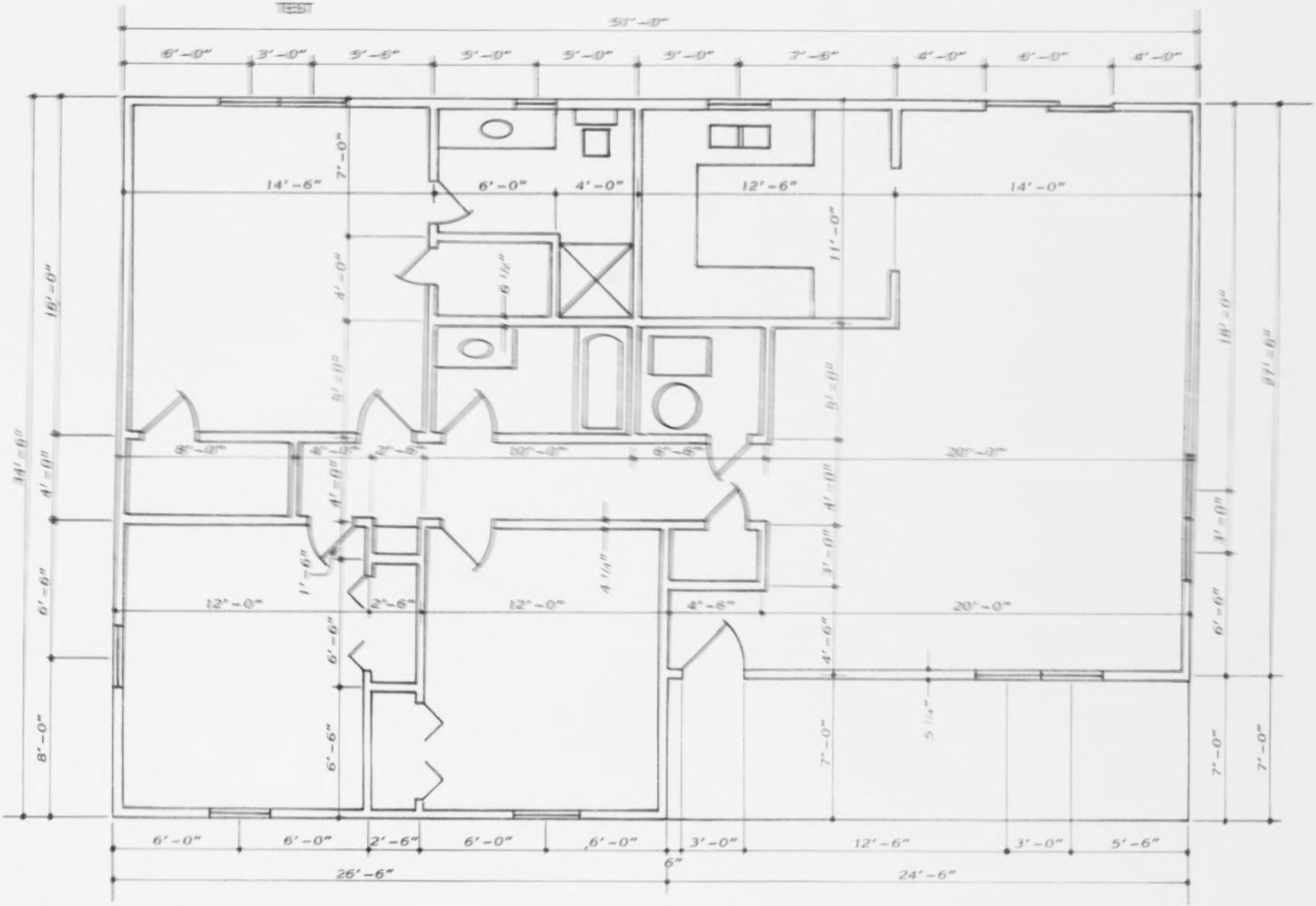
a. Lay out wall and partition locations on floor.

b. Cut studs, trimmers, cripples, and headers to length.

c. Build corners, Ts, and headers.

d. Construct wall sections for a single story structure.

e. Lay out and install ceiling joists.


TEST
51'-0"
6'-0"
3'-0"
5'-6"
5'-0"
5'-0"
5'-0"
7'-6"
4'-0"
6'-0"
4'-0"
7'-0"
14'-6"
6'-0"
4'-0"
12'-6"
14'-0"
4'-0"
6 1/2"
11'-0"
9'-0"
9'-0"
8'-0"
4'-0"
2'-6"
10'-0"
6'-6"
20'-0"
4'-0"
4'-0"
4'-0"
4 1/4"
3'-0"
1'-6"
12'-0"
2'-6"
12'-0"
4'-6"
20'-0"
6'-6"
4'-6"
6'-6"
7'-0"
5 1/4"
34'-0"
18'-0"
4'-0"
6'-6"
8'-0"
18'-0"
27'-0"
3'-0"
6'-6"
7'-0"
7'-0"
6'-0"
6'-0"
2'-6"
6'-0"
6'-0"
3'-0"
12'-6"
3'-0"
5'-6"
6"
26'-6"
24'-6"

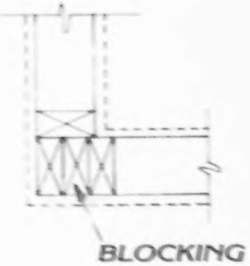
WALL AND CEILING FRAMING
UNIT II

ANSWERS TO TEST

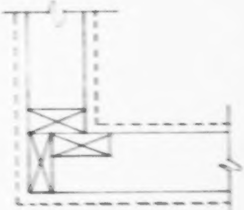
1. a. 14
   b. 9
   c. 1
   d. 7
   e. 13
   f. 3
   g. 15
   h. 4
   i. 2
   j. 8
   k. 6
   l. 10
   m. 12
   n. 5
   o. 11

2. a. Double top plate
   b. Header
   c. Top plate
   d. Cripple studs
   e. Soleplate
   f. Partition wall assembly
   g. Regular stud
   h. Corner assembly
   i. Rough sill
   j. Trimmer stud

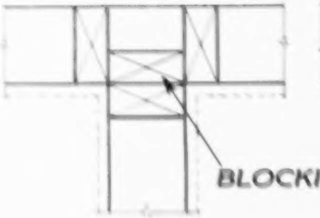
3. a.



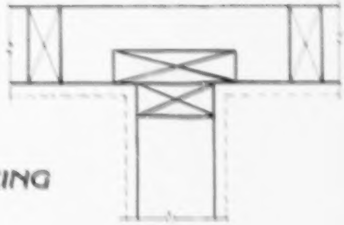
b.



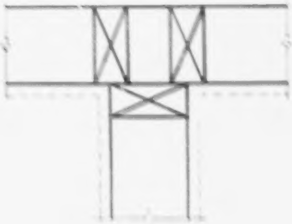
4. a.



b.



c.



5. a. Truss header
   b. Small header with cripples
   c. Solid or full header
   d. Box beam header
   e. I-beam header

6. 7'-9 1/8" or 93 1/8"

7. a. 11'-6 1/2" × 5'-6"
   b. 14'-1" × 5'-10"

ANSWERS TO TEST

8. a. 2'-10½" x 6'-10"
   b. 3'-2½" x 6'-10"
   c. 3'-8½" x 7'-2"

9. 6'-8⅝"

10. 3'-1½"

11. a, b, e, g, h, j, k, m, n, o

12. a. Permanent bracing
      1) Plywood sheathing
      2) Let-in corner bracing with 1×4 solid lumber
      3) Metal bracing
    b. Temporary bracing
      1) 2×4 wall brace
      2) Adjustable, metal wall brace

13. b, c, f, g

14. a. 369 studs or 185 - 2×4s, 16 feet long for studs
    b. 70 - 2×4s, 16 feet long for plates

15. Performance skills evaluated to the satisfaction of the instructor

ROOF FRAMING
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to identify different roof styles and discuss roof framing. The student should also be able to construct a roof, including all openings and sheathing. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with roof framing.
2. Identify roof styles.
3. Identify roof framing members.
4. Label roof framing units.
5. Discuss slope and pitch ratios.
6. Identify the parts of a rafter.
7. List methods for determining rafter length.
8. Use a framing square to compute the length of a common rafter.
9. Use a framing square to compute the length of a hip rafter.
10. Use a framing square to compute the length of jack rafters.
11. Match to their correct definitions terms associated with trusses.
12. Identify the main parts of a truss.
13. Identify types of trusses.
14. Identify hardware used in truss construction.
15. List types of vents used in roof construction.
16. Estimate material needed to frame a roof.

OBJECTIVE SHEET

17. Demonstrate the ability to

    a. Lay out rafter locations on top plate and ridgeboard on 2-foot centers.

    b. Lay out, cut, and erect rafters.

    c. Frame a gable end with vent opening.

    d. Construct opening for a chimney.

    e. Apply roof sheathing.

    f. Erect trusses for a gable roof.

ROOF FRAMING
UNIT III

SUGGESTED ACTIVITIES

I. Unit contents

  A. Objective sheet

  B. Suggested activities

  C. Transparency masters

    1. TM #1 — Roof Framing Members
    2. TM #2 — Common-Rafter Layout
    3. TM #3 — Framing-Square Step-Off Method
    4. TM #4 — Rafter Tables on a Framing Square
    5. TM #5 — Main Parts of a Truss
    6. TM #6 — Length of Ridgeboard
    7. TM #7 — Dormer Framing
    8. TM #8 — Framing an Opening

  D. Information sheet

  E. Student Supplement #1 — The Framing Square

  F. Assignment Sheet #1 — Estimate Materials Needed to Frame a Roof

  G. Answers to assignment sheet

  H. Job sheets

    1. Job Sheet #1 — Lay Out Rafter Locations on the Top Plate and Ridgeboard on 2-Foot Centers
    2. Job Sheet #2 — Lay Out, Cut, and Erect Rafters
    3. Job Sheet #3 — Frame a Gable End with Vent Opening
    4. Job Sheet #4 — Construct Opening for a Chimney
    5. Job Sheet #5 — Apply Roof Sheathing
    6. Job Sheet #6 — Erect Trusses on a Gable Roof

  I. Test

  J. Answers to test

SUGGESTED ACTIVITIES

II. Instructor's guide

A. Review unit and plan presentation.

B. Obtain materials to supplement unit.

1. Pictures of various roof styles
2. House plans to clarify definitions of terms associated with roof framing
3. Pictures or plans of various roof styles
4. Model to illustrate roof framing members
5. Local building regulations concerning roof framing and ventilation capacities
6. Model to illustrate roof units
7. Plans, tables, etc., that illustrate roof framing units and slope and pitch ratios
8. Color-coded model of a rafter
9. Framing square for each student
10. Model to explain why a common rafter must be shortened one-half the thickness of the ridgeboard
11. *Gang-Nail Roof and Truss Systems.* Available from Automated Building Components, Inc., Miami, Florida
12. Samples of hardware used in truss construction
13. Samples of vents used in roof construction
14. Literature from vent manufacturers
15. Transparency masters and compentency profiles

    (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational-Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

SUGGESTED ACTIVITIES

C. Introduce unit.

SUGGESTIONS:

- Show the class pictures of various roof styles and emphasize how many different styles of roofs can be used for the same floor plan.

  (NOTE: You may want to use a front-elevation plan and overlay different roof designs so that the students can see the elevation with a gable, a hip, a modified hip, and other styles.)

- Use a framing square and Transparency #6 to show the calculations involved in roof framing. Emphasize the need for careful calculations to ensure proper fit.

  (NOTE: Emphasize the importance of mastering calculating skills, but do not make the task seem so difficult that students become discouraged.)

D. Provide students with objective sheet; discuss unit and specific objectives.

E. Provide students with information, assignment, and job sheets.

F. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Section I to discuss terms associated with roof framing. Use house plans to clarify the definitions.

2. Use Information Sheet, Section II to discuss roof styles.

   SUGGESTIONS:

   - Display pictures of finished roofs or plans of the roof styles illustrated in this section of the information sheet.
   - Have students discuss houses in your area with various roof styles.
   - Discuss variations in and combinations of these roof styles.

3. Use Information Sheet, Section III and Transparency #1 to discuss roof framing members.

   (NOTE: A good reference for this section of the information sheet and the sections that follow is *Full-Length Roof Framer.* See Section III of Suggested Activities.)

   SUGGESTIONS:

   - Display a model to illustrate roof framing members three dimensionally.

SUGGESTED ACTIVITIES

- Discuss lumber sizes and grade requirements for roof framing members. Emphasize local building regulations.

- Tour construction sites to observe various roof styles in the framing stages.

- Relate styles of roofs to the various members discussed.

  (NOTE: Some students have difficulty envisioning the three-dimensional structure from line drawings. Provide additional help as needed and suggest ways that such students can improve their skills in this area, such as by constructing models or doing drawings with different views.)

4. Use Information Sheet, Secton IV and Transparency #2 to discuss roof framing units; use Information Sheet, Section V to discuss slope and pitch ratios.

   SUGGESTIONS:

   - Use a small model to discuss roof units. Emphasize the relationship among the units.

     EXAMPLES: Run is always stated as 12 inches; span is always stated as 24 inches; as rise increases, unit length and slope increase and projection decreases.

   - Make sure that students clearly understand pitch and slope; have the students compute pitch and slope for different rises and runs.

   - Provide students with plans, tables, etc., that use roof framing units and slope and pitch.

5. Use Information Sheet, Section VI to discuss parts of a rafter.

   SUGGESTIONS:

   - Display a color-coded model of a rafter to discuss the parts illustrated in this section of information sheet.

   - Discuss types of tail cuts.

     (NOTE: Tail cuts are covered in detail in Section E, Unit II, Roof Finishes.)

6. Use Information Sheet, Section VII and Transparencies #3 and #4 to discuss methods of determing rafter length; demonstrate each method.

SUGGESTED ACTIVITIES

7. Use Information Sheet, Section VIII and Student Supplement #1 to discuss using a framing square to compute the length of a common rafter.

   SUGGESTIONS:

   - Demonstrate the procedure and allow students to follow along on the supplement or with actual framing squares.
   - Use Transparency #6 or a model to explain why a common rafter must be shortened one-half the thickness of the ridgeboard.

8. Use Information Sheet, Sections IX and X to discuss using a framing square to compute rafter lengths for a hip rafter and jack rafter, relating the procedures to that used for a common rafter.

   SUGGESTION:

   - Make it clear to the students how the angles and lengths affect one another.

9. Provide students with Assignment Sheet #1 and house plans to practice computing rafter lengths.

10. Use Information Sheet, Sections XI and XII and Transparency #5 to discuss terms associated with trusses and the main parts of a truss; use Section XIII to discuss types of trusses, emphasizing that the trusses illustrated in Section XIII are only a small number of the truss designs that are available.

    SUGGESTIONS:

    - Supplement the discussion with information from manufacturers, such as *Gang-Nail Roof and Truss Systems.*
    - Relate truss parts to framing members, and discuss the advantages and disadvantages of each type of framing.
    - Relate truss designs to roofing styles and to styles of ceiling designs.

11. Use Information Sheet, Section XIV to discuss hardware used in truss construction.

    SUGGESTIONS:

    - Discuss or demonstrate the use of the various types of hardware illustrated in this section of the information sheet.
    - Discuss methods of truss fabrication.
    - Tour a truss plant to view the manufacture of trusses; if possible, visit a facility that uses computers or computer linkage to compute truss designs.
    - Visit a construction site to view trusses being erected.

SUGGESTED ACTIVITIES

12. Use Information Sheet, Section XV to discuss types of vents used in roof construction.

    SUGGESTIONS:

    - Show the class samples of each type of vent discussed in this section of the information sheet.
    - Discuss the purpose of roof ventilation or invite a manufacturer or distributor of roof-ventilation hardware to discuss vent applicatons.
    - Display literature from vent manufacturers.
    - Relate designs and sizes to ventilation capacities, emphasizing local regulations.

13. Use Information Sheet, Section XVI and Transparency #6 to discuss estimating material needed to frame a roof.

    SUGGESTIONS:

    - Have students practice estimating material by completing Assignment Sheet #1.
    - Provide students with plans to estimate materials.
    - Have students compute cost differences in framing materials for houses using different pitches, different designs, or prefabricated trusses instead of on-site framing.
    - Use Transparencies #7 and #8 to discuss other considerations in framing materials.

G. Discuss job sheets and demonstrate procedures.

SUGGESTIONS:

- Review safety requirements, empahsizing ladder and scaffolding safety.
- Review framing concepts studied in previous units.
- Relate Job Sheet #1 to joist layout and installation.
- Allow students to practice procedures in Job Sheet #2; you may wish to allow students to make the pattern rafters and do the computations for other rafters required for the example used in the job sheet.

SUGGESTED ACTIVITIES

H. Have students complete job sheets.

I. Give test.

J. Critique test and discuss in class.

K. Reteach if necessary.

L. Complete appropriate portions of competency profiles.

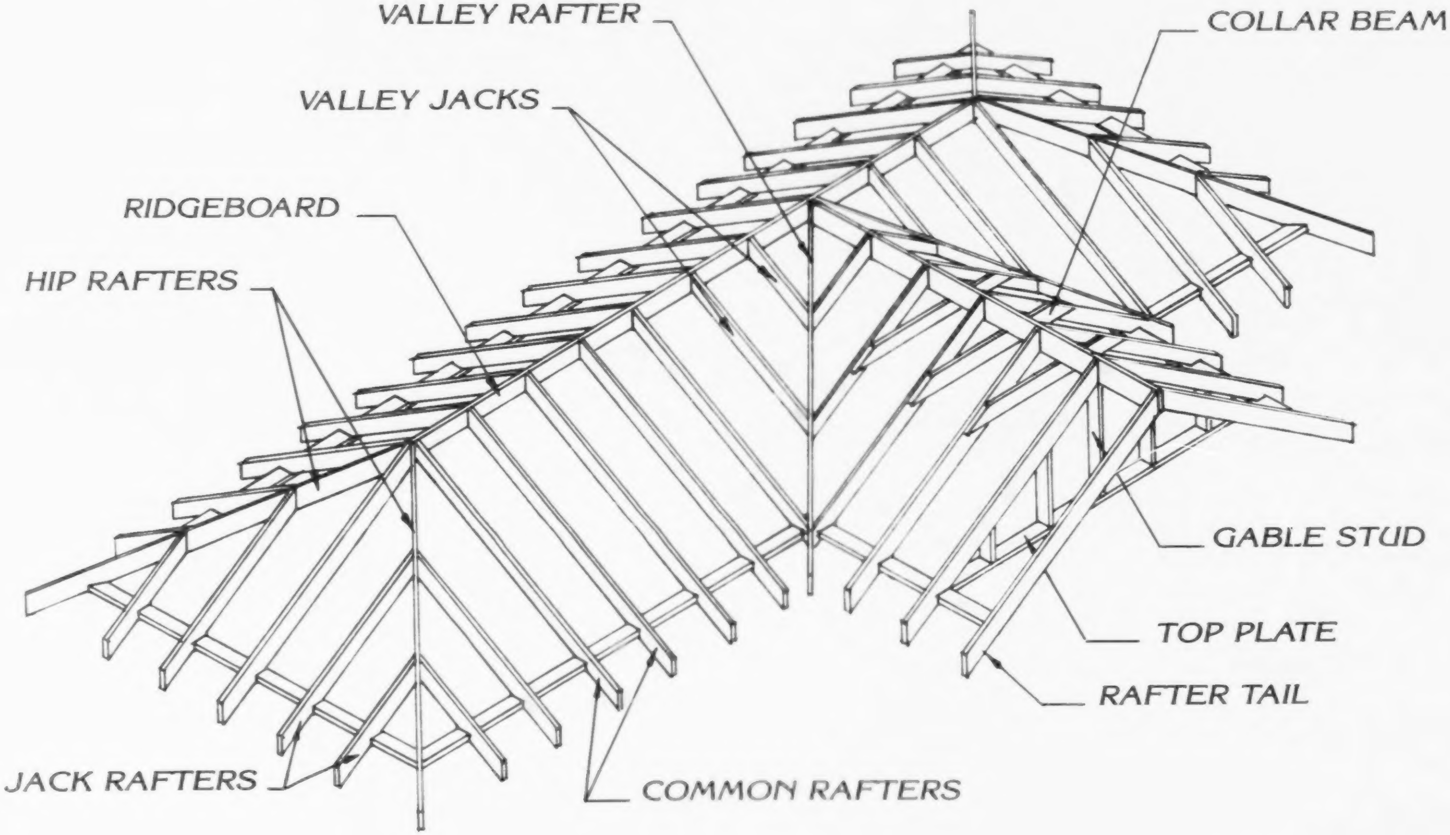
III. Unit references

A. Hendrix, Laborn J. "Bud." *Commercial Carpentry.* Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1979.

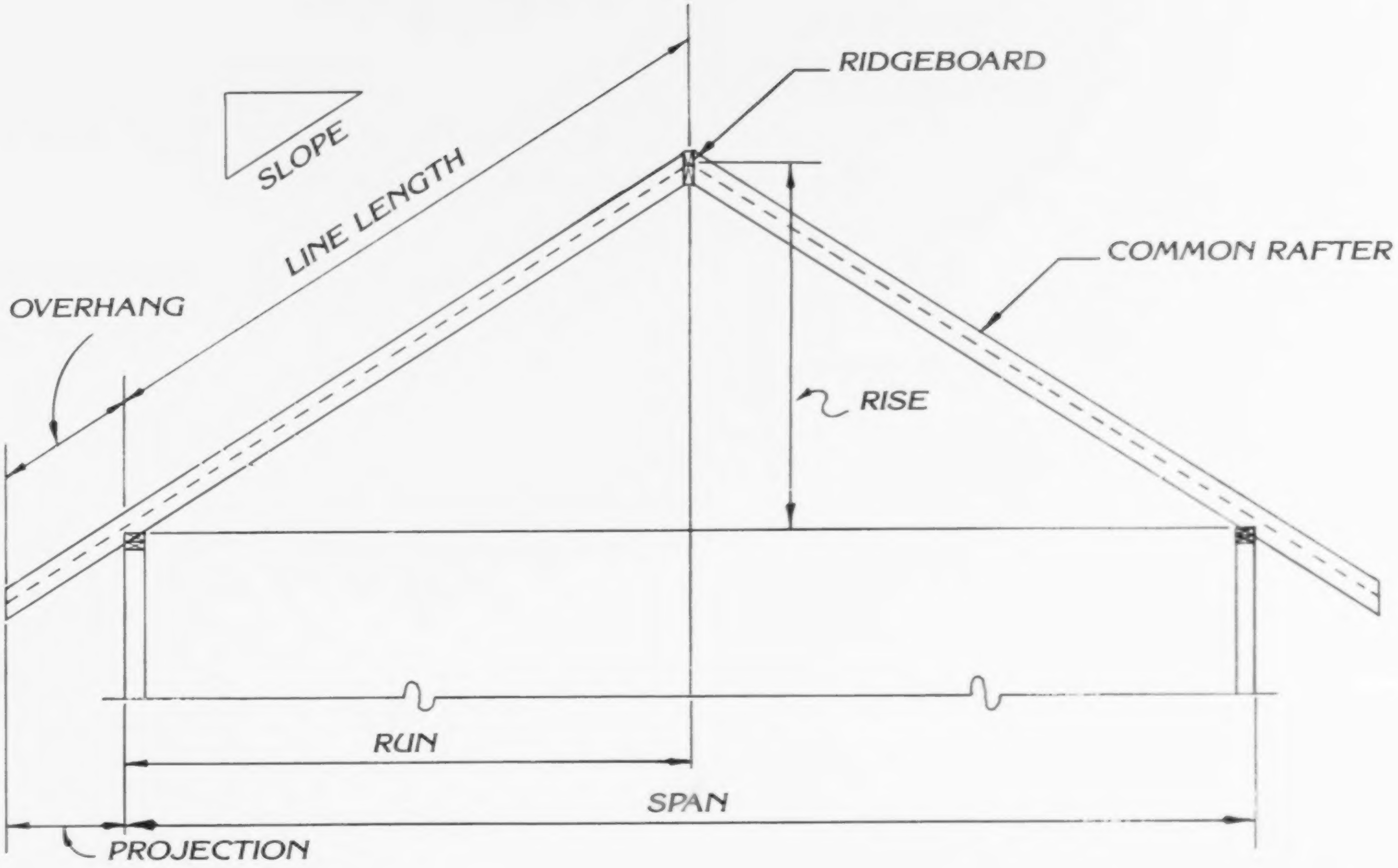
B. Riechers, A. F. J. *Full-Length Roof Framer.* Palo Alto, California: Ledever, Street, and Zeus Co., Inc., 1944.

C. Wagner, Willis H. *Modern Carpentry.* South Holland, Illinois: The Goodheart-Willcox Company, 1976.

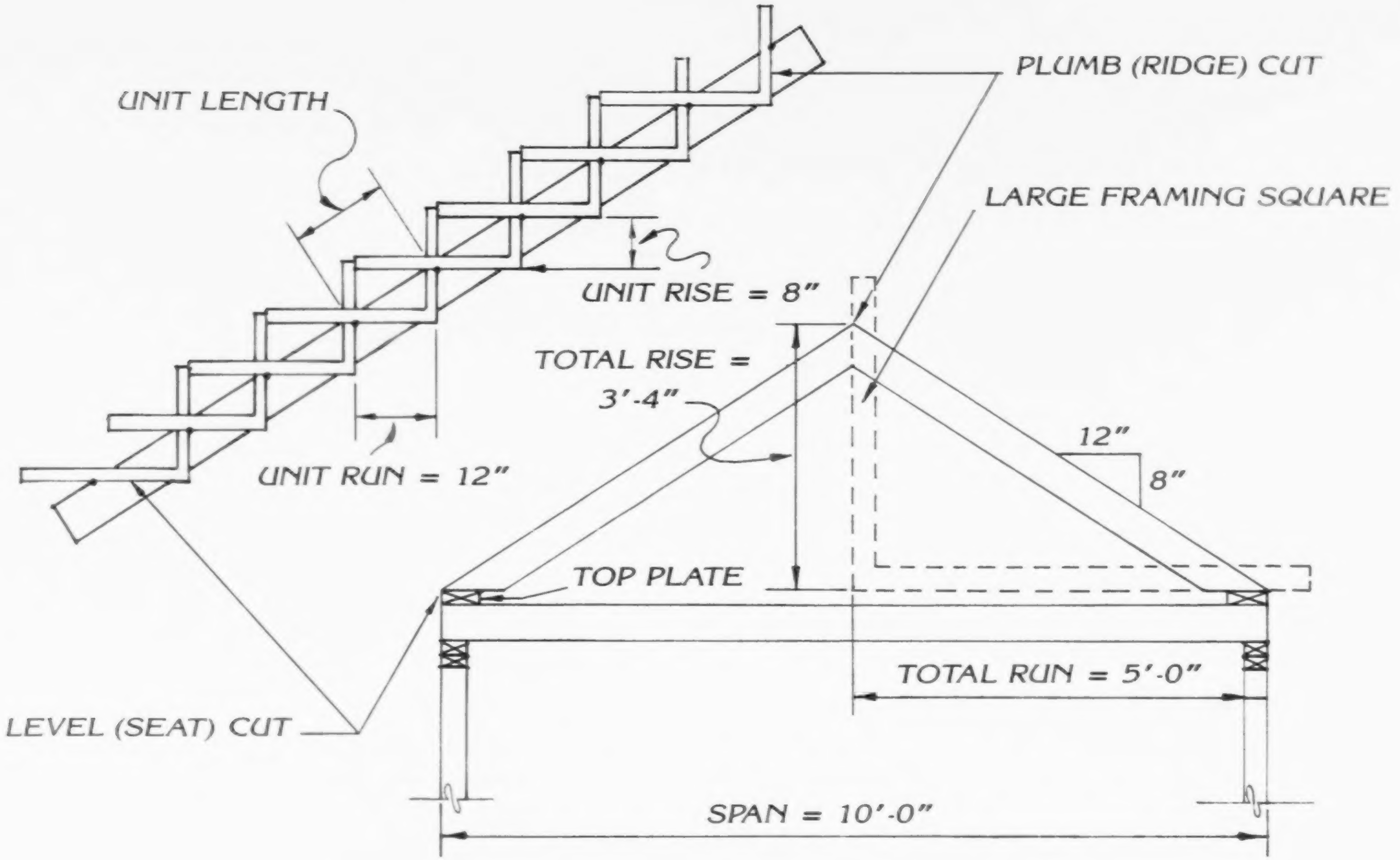
Roof Framing Members


VALLEY RAFTER
COLLAR BEAM
VALLEY JACKS
RIDGEBOARD
HIP RAFTERS
GABLE STUD
TOP PLATE
RAFTER TAIL
HIP JACK RAFTERS
COMMON RAFTERS

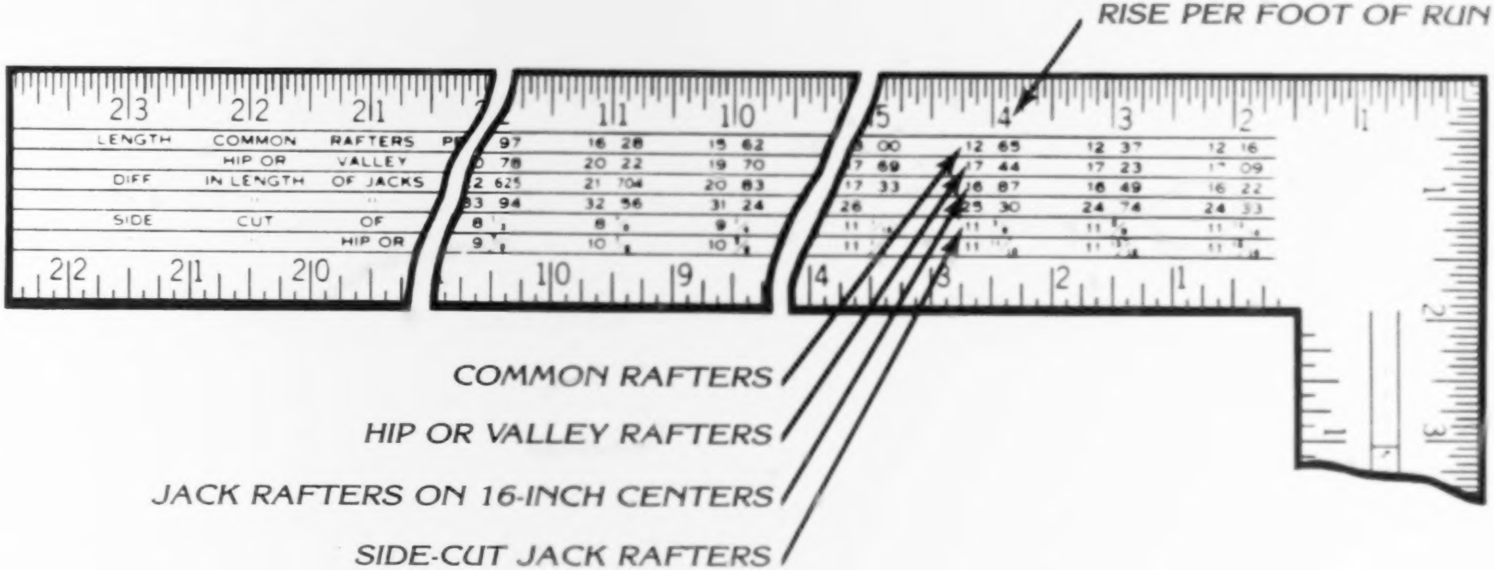
Common-Rafter Layout


RIDGEBOARD
SLOPE
LINE LENGTH
COMMON RAFTER
OVERHANG
RISE
RUN
SPAN
PROJECTION

Framing-Square Step-Off Method


UNIT LENGTH
PLUMB (RIDGE) CUT
LARGE FRAMING SQUARE
UNIT RISE = 8"
TOTAL RISE = 3'-4"
12"
8"
UNIT RUN = 12"
TOP PLATE
TOTAL RUN = 5'-0"
LEVEL (SEAT) CUT
SPAN = 10'-0"

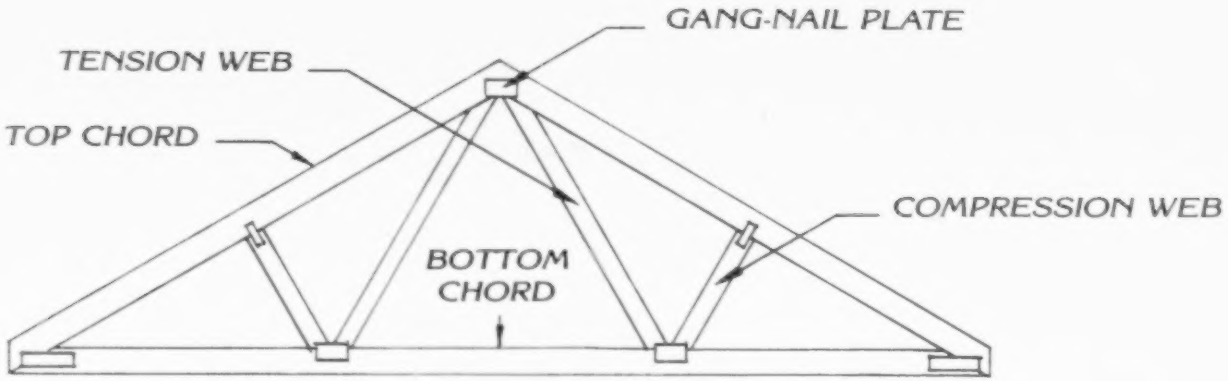
Rafter Tables on a Framing Square


RISE PER FOOT OF RUN
LENGTH COMMON RAFTERS PE
HIP OR VALLEY
DIFF IN LENGTH OF JACKS
SIDE CUT OF
HIP OR
23 22 21 11 10 5 4 3 2 1
22 21 20 10 9 14 13 12 11
97 16 28 15 62 00 12 65 12 37 12 16
78 20 22 19 70 17 69 17 44 17 23 17 09
2 625 21 704 20 83 17 33 16 87 16 49 16 22
33 94 32 56 31 24 26 25 30 24 74 24 33
COMMON RAFTERS
HIP OR VALLEY RAFTERS
JACK RAFTERS ON 16-INCH CENTERS
SIDE-CUT JACK RAFTERS

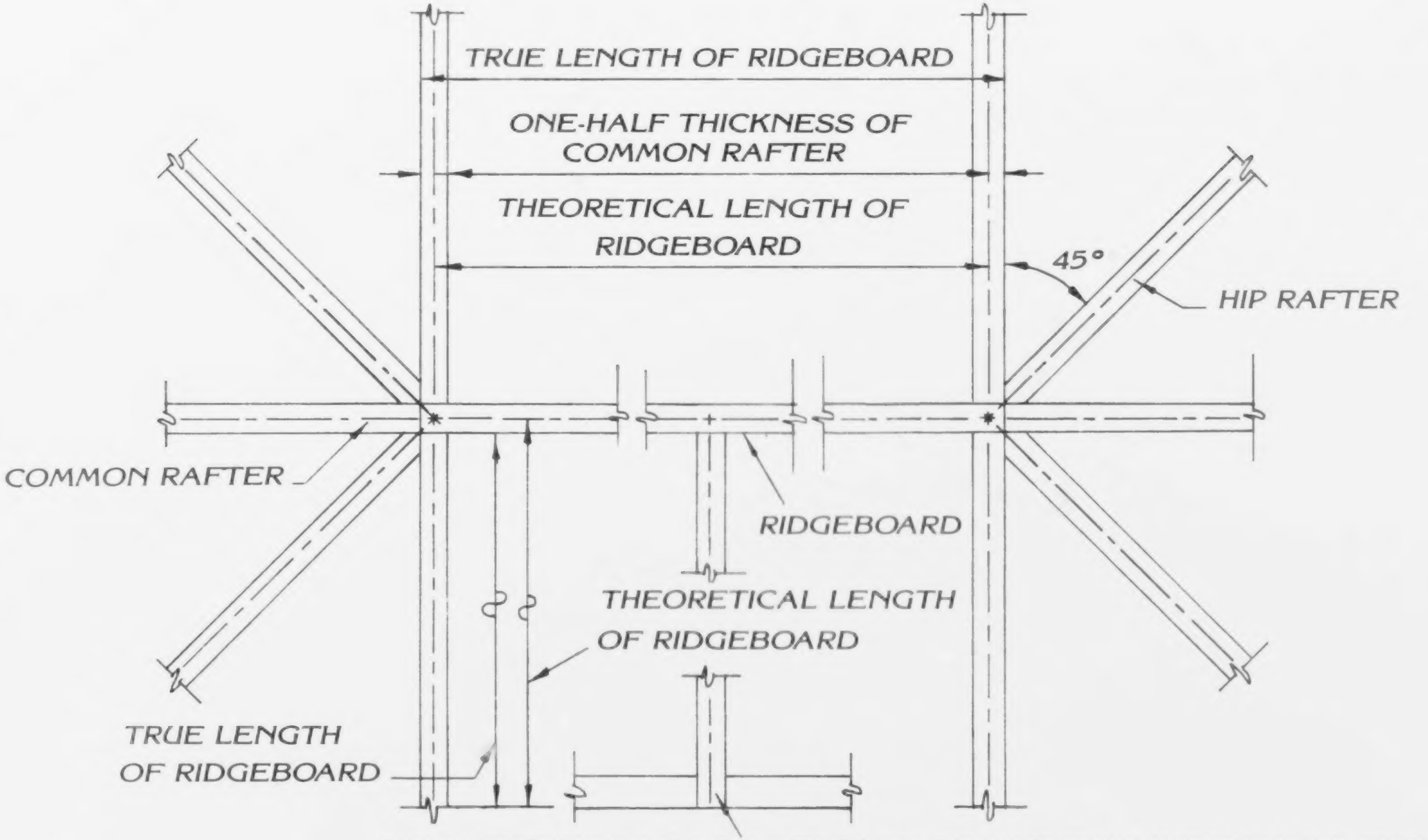
431

432

Main Parts of a Truss


GANG-NAIL PLATE
TENSION WEB
TOP CHORD
COMPRESSION WEB
BOTTOM CHORD

Length of Ridgeboard

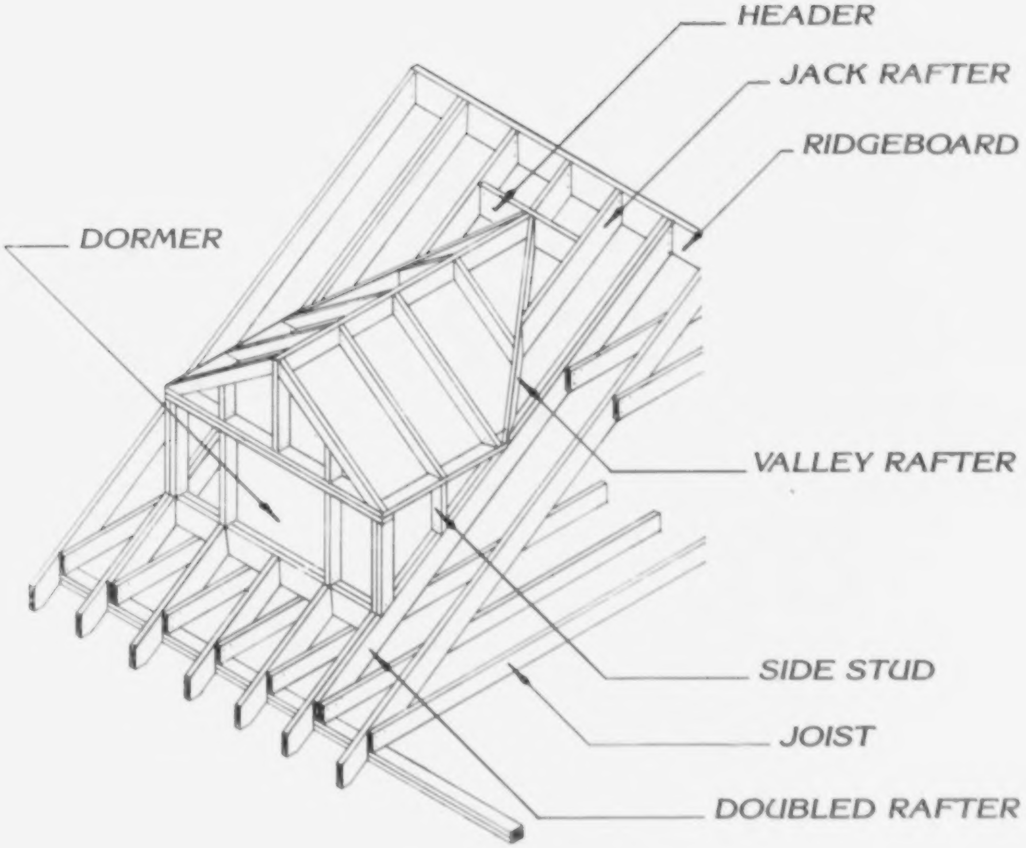

TRUE LENGTH OF RIDGEBOARD
ONE-HALF THICKNESS OF COMMON RAFTER
THEORETICAL LENGTH OF RIDGEBOARD
45°
HIP RAFTER
COMMON RAFTER
RIDGEBOARD
THEORETICAL LENGTH OF RIDGEBOARD
TRUE LENGTH OF RIDGEBOARD

INTERSECTING-ROOF RIDGEBOARD OF ADDITION WITH GABLE END

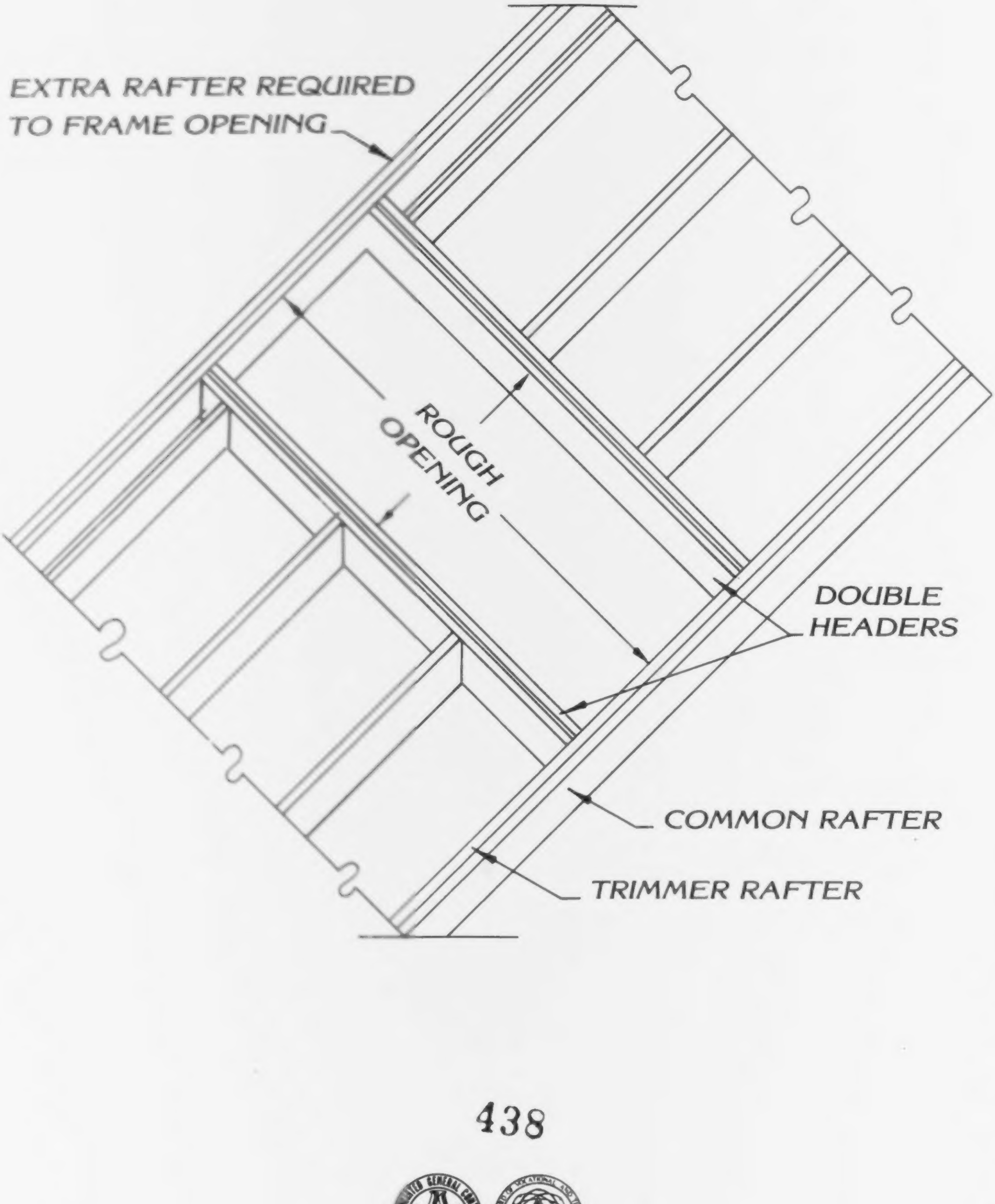
TM #6

RC - 183-D

Dormer Framing


HEADER
JACK RAFTER
RIDGEBOARD
DORMER
VALLEY RAFTER
SIDE STUD
JOIST
DOUBLED RAFTER

Framing an Opening


EXTRA RAFTER REQUIRED TO FRAME OPENING
ROUGH OPENING
DOUBLE HEADERS
COMMON RAFTER
TRIMMER RAFTER

ROOF FRAMING
UNIT III

INFORMATION SHEET

I. Terms and definitions associated with roof framing

   A. Common rafter — Rafter that extends from double top plate to ridgeboard; roof's main framing member

   B. Valley rafter — Rafter that extends diagonally from top plate to form the intersection of an internal roof angle

   C. Hip rafter — Rafter that extends from double top plate at corner of structure to ridgeboard, forming the angle for a hip roof

   D. Jack rafter — Short rafter that fits between top plate and hip or valley rafter, or between ridgeboard and hip or valley rafter

      (NOTE: When fitted between hip and valley rafter, a jack rafter is called a *cripple jack*.)

   E. Barge rafter (verge rafter) — Exposed rafter that is located at end of gable roof

   F. Pitch — Angle or degree of slope of roof

   G. Slope — Inclination of roof's surface expressed as one unit of rise or fall to so many horizontal units, usually "X" inches in twelve

      EXAMPLES: 4 in 12, 5 in 12

   H. Span — Horizontal distance from outside of one exterior wall to outside of opposite exterior wall

   I. Run — Horizontal distance from outside of top plate to center line of ridgeboard; usually one-half of span

   J. Rise — Total height of rafter above top plate

   K. Projection — Horizontal distance from building to edge of roof

   L. Overhang — Section of roof that extends from building line to edge of roof

   M. Rake — Trim members that run parallel to roof slope and form finish between roof and wall at gable end

   N. Dormer — Structure that projects from a sloping roof and usually includes a window

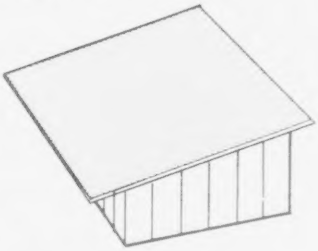
   O. Strongback (stiffback) — Brace used in framing to strengthen or improve alignment of other framing members

INFORMATION SHEET

II. Roof styles (Figures 1-11)

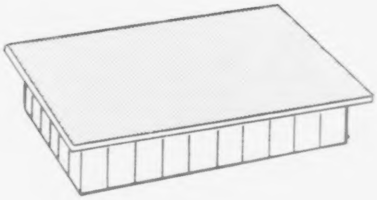
A. Shed roof (lean-to roof)

FIGURE 1



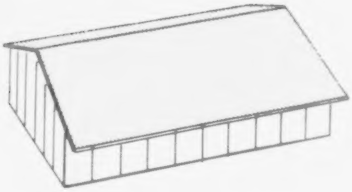
B. Flat roof

FIGURE 2



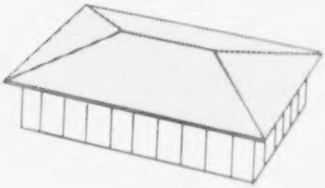
C. Gable roof

FIGURE 3



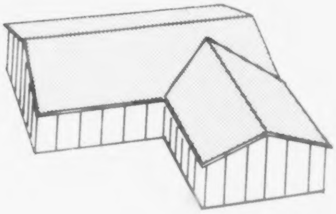
D. Hip roof

FIGURE 4



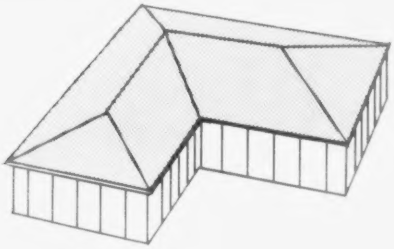
E. L-shaped gable roof

FIGURE 5



F. L-shaped hip roof

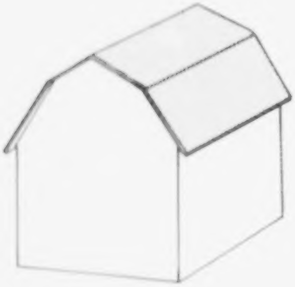
FIGURE 6



INFORMATION SHEET

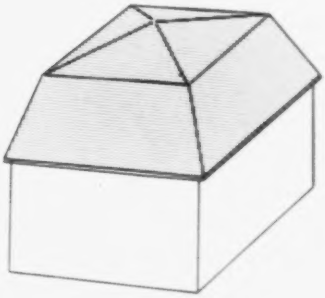
G. Gambrel roof

FIGURE 7



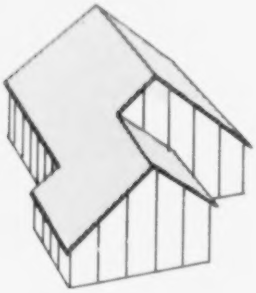
H. Mansard roof

FIGURE 8



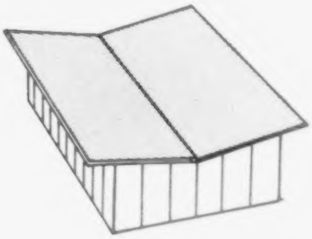
I. Continuous-slope gable roof

FIGURE 9



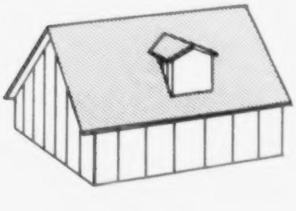
J. Butterfly roof

FIGURE 10



K. Gable roof with dormer

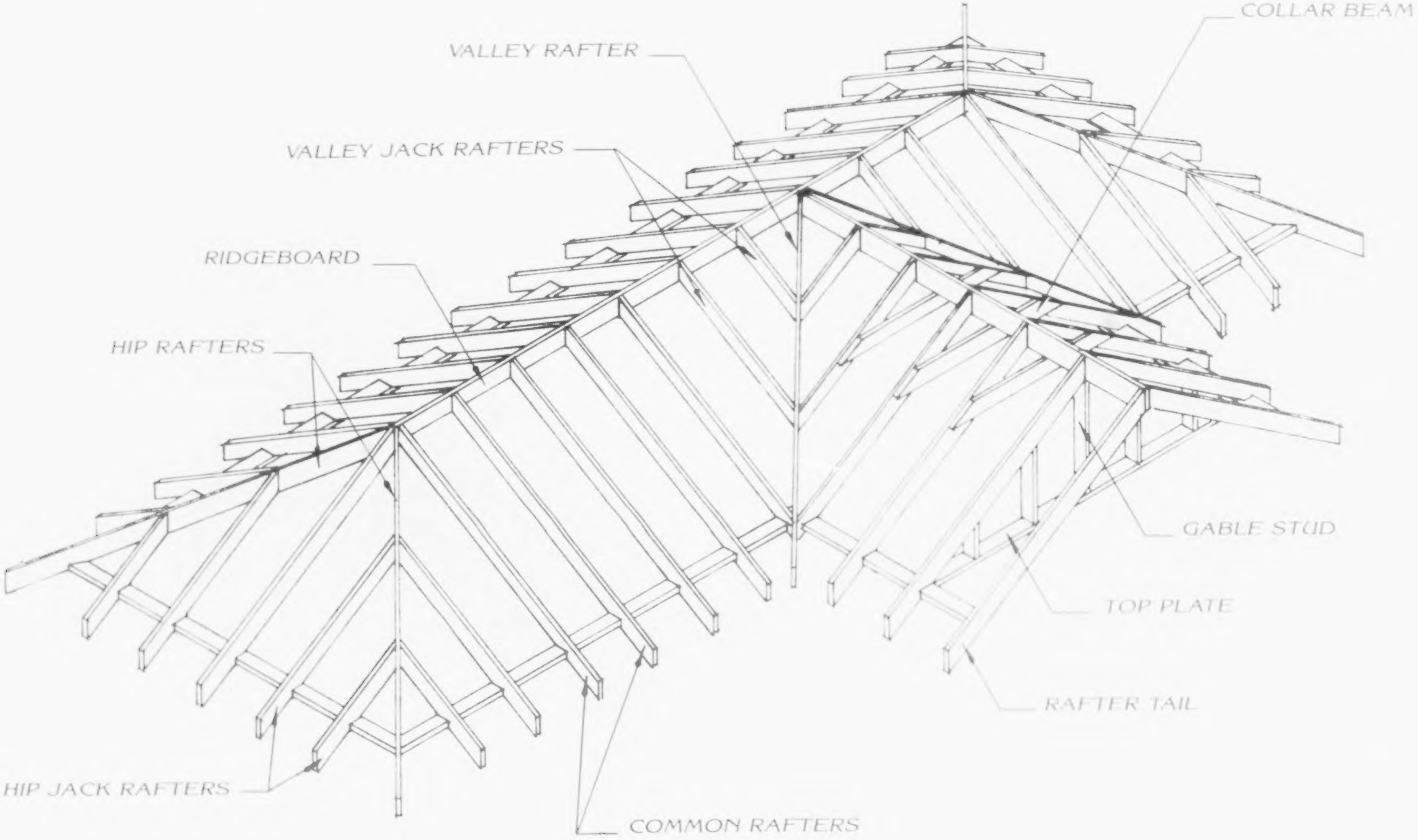
FIGURE 11



INFORMATION SHEET

III. Roof framing members (Figure 12)

FIGURE 12


COLLAR BEAM
VALLEY RAFTER
VALLEY JACK RAFTERS
RIDGEBOARD
HIP RAFTERS
GABLE STUD
TOP PLATE
RAFTER TAIL
HIP JACK RAFTERS
COMMON RAFTERS

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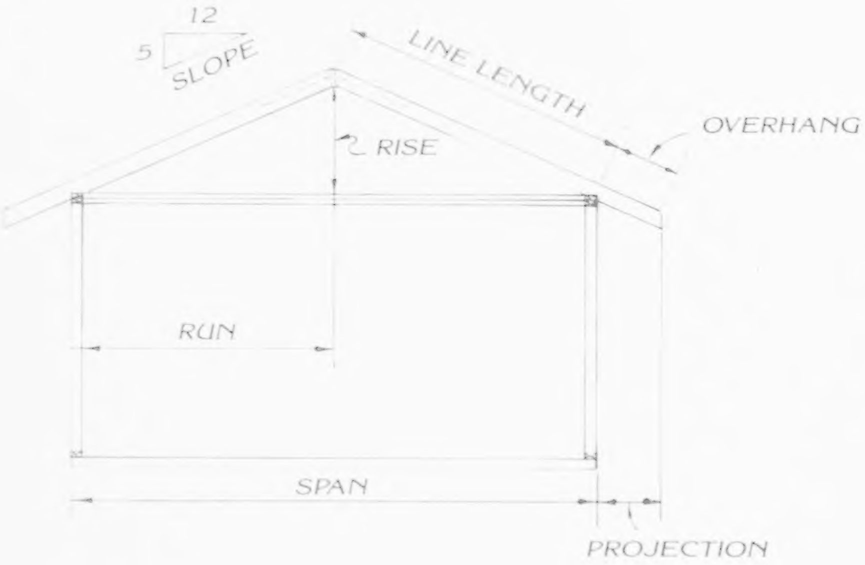
INFORMATION SHEET

IV. Roof framing units (Figure 13)

FIGURE 13


12
5
SLOPE
LINE LENGTH
OVERHANG
℄ RISE
RUN
SPAN
PROJECTION

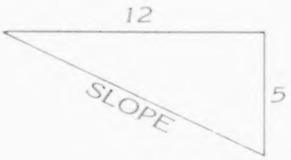
V. Slope and pitch ratios

A. Slope — Indicates incline of roof as a ratio of vertical rise to horizontal run

(NOTE: Slope is properly expressed as "X" inches in twelve. For example, a roof that has a rise of 5 inches for each foot of run is referred to as having a 5 in 12 slope. See Figure 14.)

EXAMPLE:

FIGURE 14



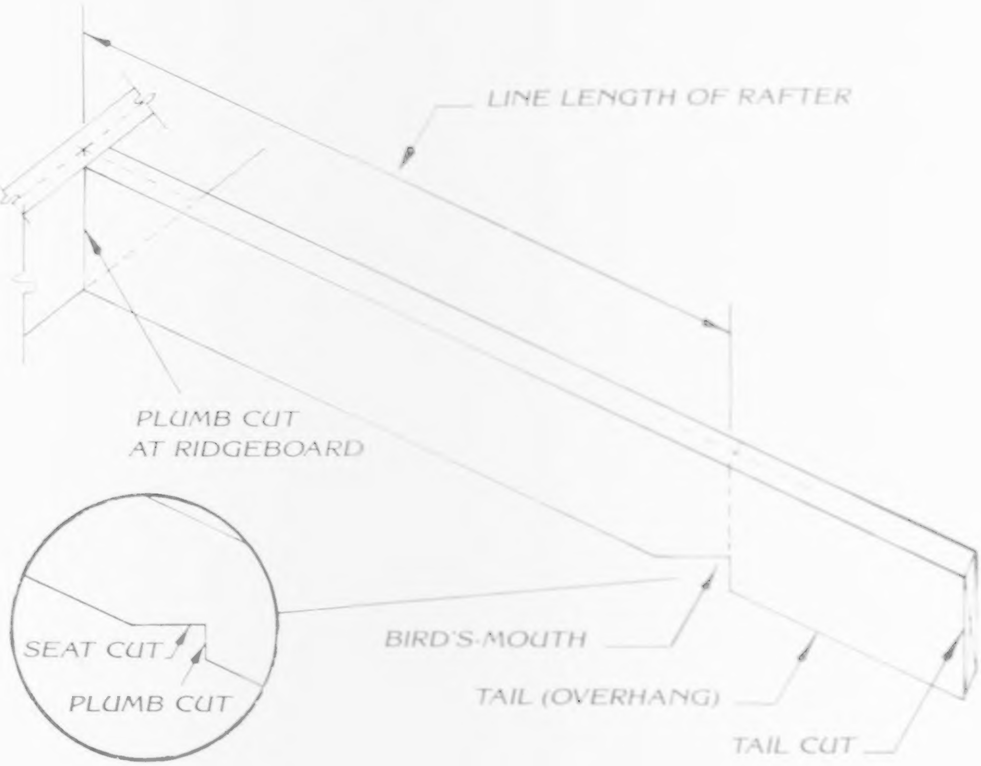
B. Pitch — Indicates incline of roof as a ratio of vertical rise to span

(NOTE: Pitch is expressed as a fraction. For example, if the total roof rise is 6 feet and total span is 24 feet, the pitch would be ¼.)

INFORMATION SHEET

VI. Parts of a rafter (Figure 15)

FIGURE 15


LINE LENGTH OF RAFTER
PLUMB CUT AT RIDGEBOARD
SEAT CUT
PLUMB CUT
BIRD'S-MOUTH
TAIL (OVERHANG)
TAIL CUT

VII. Methods for determining rafter length

A. Framing-square step-off method

B. Rafter tables

(NOTE: Rafter tables are usually located on the backs of framing squares. Rafter tables usually give lengths in length per foot of run, but some tables give lengths in length per given run.)

VIII. Using a framing square to compute the length of a common rafter

(NOTE: Refer to the framing square illustrated in Student Supplement #1 at the end of the information sheet.)

A. Determine common-rafter span (in inches) by measuring from outside of top plate on one sidewall to outside of top plate on opposite sidewall

INFORMATION SHEET

B. Divide span by 2 to find actual run of common rafter

(NOTE: Actual run equals one-half of span.)

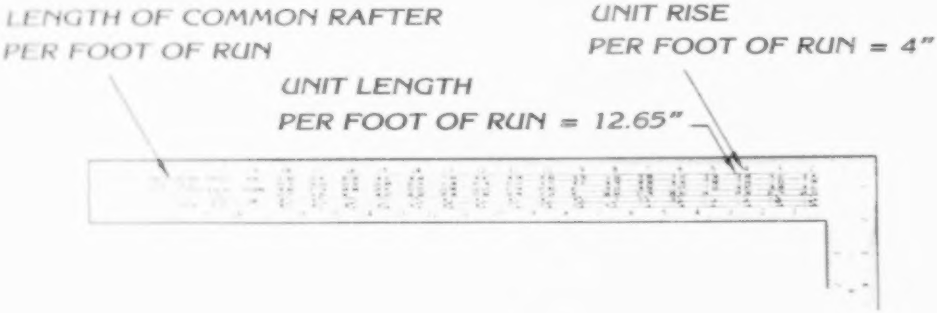
C. Determine inches of rise per foot of run

D. Determine shortened length of common rafter

1. Locate unit rise per foot of run on blade of framing square

EXAMPLE: If unit rise is 4 inches per foot of run, locate the number four on the edge of the framing-square blade. See Figure 16.

FIGURE 16



2. Read figure under unit rise per foot of run to find the unit length per foot of run for the common rafter

EXAMPLE: If the span for a structure is 20'-0" and the unit rise per foot of run is 4 inches, then the unit length per foot of run is 12.65 inches. See Figure 16.

3. Multiply unit length per foot of run by actual run and divide by 12 (12 inches equal 1 foot) to find the length of common rafter in feet and inches, or

Unit Length per Foot of Run × Actual Run ÷ 12 = Length of Common Rafter

EXAMPLE #1: If the actual run of a structure is 10 and unit length per foot of run is 12.65 inches, then

$$\frac{12.65'' \times 10}{12} = \frac{126.50 \text{ inches}}{12} = 10.54 \text{ feet, which } = 10'\text{-}6\ 1/2''$$

INFORMATION SHEET

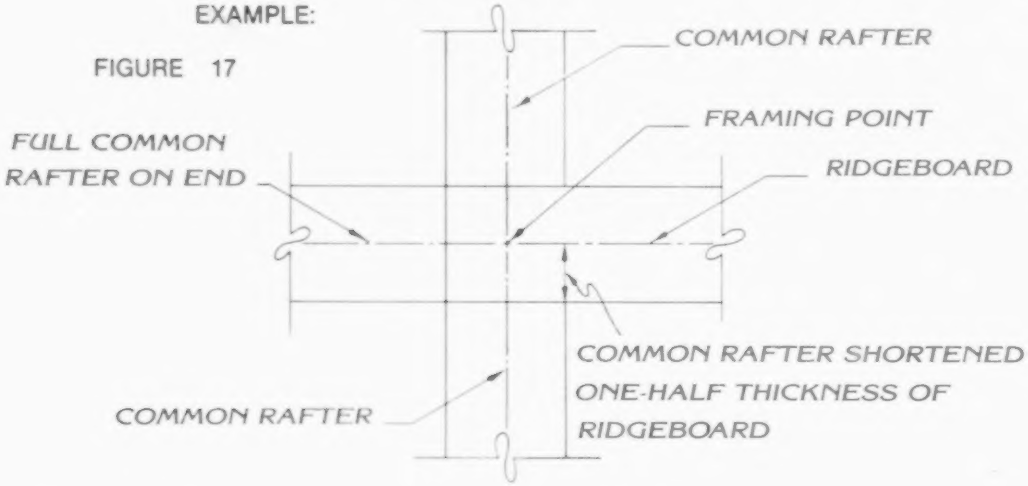
EXAMPLE #2: If the actual run of a structure is 12.3 and unit length per foot of run is 12.42 inches, then

$$\frac{12.42'' \times 12.3}{12} = \frac{152.77 \text{ inches}}{12} = 12.73 \text{ feet, which} = 12'\text{-}8\ ^3\!/\!_4{}''$$

4. Subtract one-half thickness of ridgeboard (measured perpendicular to plumb cut of rafter) from length of common rafter to find shortened length of common rafter (Figure 17)

EXAMPLE:

FIGURE 17


COMMON RAFTER
FRAMING POINT
FULL COMMON RAFTER ON END
RIDGEBOARD
COMMON RAFTER SHORTENED ONE-HALF THICKNESS OF RIDGEBOARD
COMMON RAFTER

IX. Using a framing square to compute the length of a hip rafter

(NOTE: Refer to the framing square illustrated in Student Supplement #1 at the end of the information sheet.)

A. Determine the hip-rafter span (in inches) by measuring from outside of top plate on one sidewall to outside of top plate on opposite sidewall

B. Divide span by 2 to find actual run of hip rafter

(NOTE: Actual run equals one-half of span.)

C. Determine inches of rise per foot of run

D. Determine shortened length of hip rafter

1. Locate unit rise per foot of run on blade of framing square (See Figure 18)

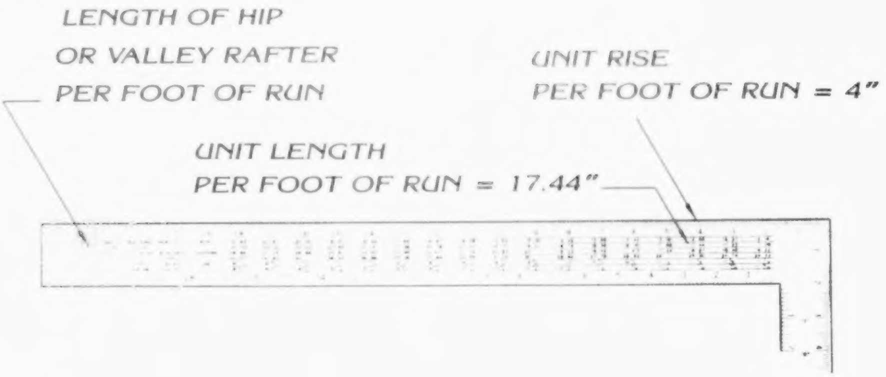
2. Read figure under unit rise per foot of run to find the unit length per foot of run for the hip or valley rafter

EXAMPLE: If the unit rise is 4 inches per foot of run, the unit length is 17.44 inches per foot of run. (See Figure 18)

INFORMATION SHEET

EXAMPLE:

FIGURE 18


LENGTH OF HIP
OR VALLEY RAFTER
PER FOOT OF RUN
UNIT RISE
PER FOOT OF RUN = 4"
UNIT LENGTH
PER FOOT OF RUN = 17.44"

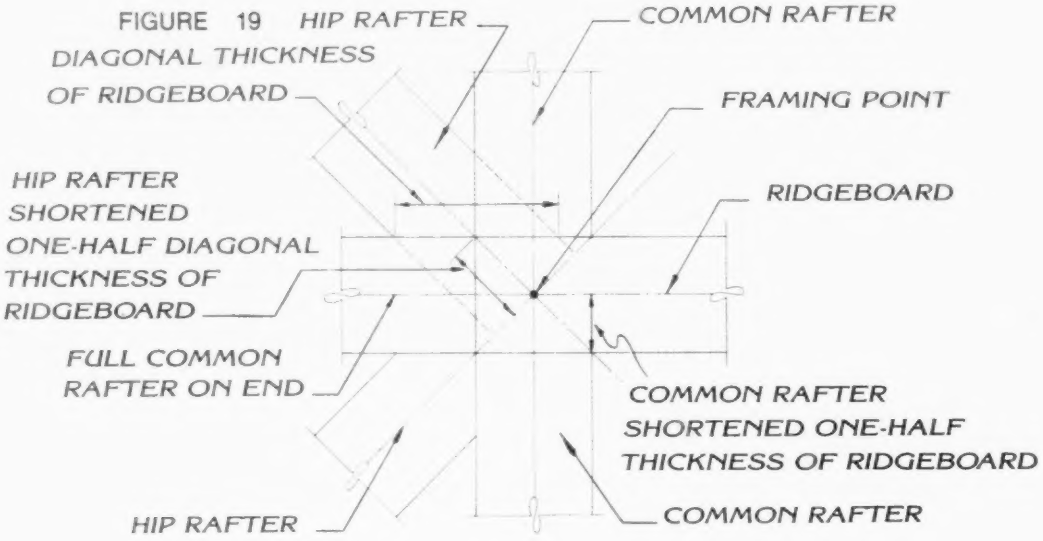
3. Multiply unit length per foot of run by actual run and divide by 12 to find the length of hip rafter (in feet), or

$$\frac{\text{Unit Length per Foot of Run} \times \text{Actual Run}}{12} = \text{Length of Hip Rafter}$$

4. Subtract one-half diagonal thickness of ridgeboard from length of hip rafter to find shortened length of hip rafter (Figure 19)

EXAMPLE:

FIGURE 19


HIP RAFTER
COMMON RAFTER
DIAGONAL THICKNESS
OF RIDGEBOARD
FRAMING POINT
HIP RAFTER
SHORTENED
ONE-HALF DIAGONAL
THICKNESS OF
RIDGEBOARD
RIDGEBOARD
FULL COMMON
RAFTER ON END
COMMON RAFTER
SHORTENED ONE-HALF
THICKNESS OF RIDGEBOARD
HIP RAFTER
COMMON RAFTER

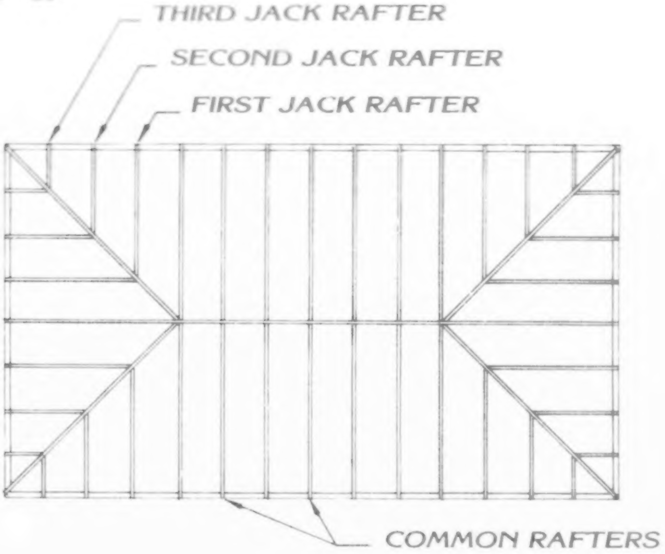
INFORMATION SHEET

X. Using a framing square to compute the length of jack rafters

(NOTE: Refer to the framing square illustrated in Student Supplement #1 at the end of the information sheet and to Figure 20.)

EXAMPLE:

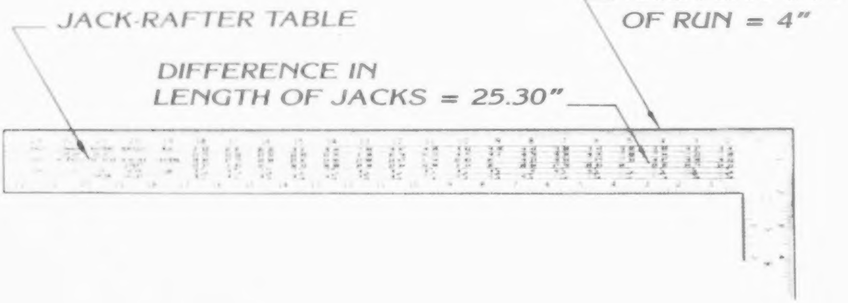
FIGURE 20


THIRD JACK RAFTER
SECOND JACK RAFTER
FIRST JACK RAFTER
COMMON RAFTERS

A. Locate unit rise per foot of run on blade of framing square (Figure 21)

EXAMPLE:

FIGURE 21


JACK-RAFTER TABLE
RISE PER FOOT OF RUN = 4"
DIFFERENCE IN LENGTH OF JACKS = 25.30"

INFORMATION SHEET

B. Determine shortened length of common rafter (See Section VIII of information sheet)

C. Determine difference in length of jacks by locating table on blade of framing square

EXAMPLE: If the unit rise is 4 inches, the difference in length for jacks is 25.30 inches. See Figure 21.

D. Subtract difference in length of jacks from shortened length of common rafter (in inches) to find length of first jack rafter, or

Common Rafter Length - Difference in Length of Jacks = Length of First Jack Rafter

EXAMPLE: If the difference in length for jacks is 25.30 inches, the length of the first jack rafter will be 25.30 inches shorter than that of the shortened common rafter.

E. Subtract the difference in length of jacks from length of first jack rafter to find length of second jack rafter

EXAMPLE: If the difference in length for jacks is 25.30 inches, the second jack rafter will be 25.30 inches shorter than the first jack rafter.

F. Subtract the difference in length of jacks from length of second jack rafter to find length of third jack rafter

EXAMPLE: If the difference in length for jacks is 25.30 inches, the third jack rafter will be 25.30 inches shorter than the second jack rafter.

G. Follow procedure above to compute the length of all jack rafters that will be required

XI. Terms and definitions associated with trusses

A. Truss — Combination of framing members that is usually constructed in a triangular unit and used as a rigid framework to support loads over long spans

(NOTE: Trusses come in a number of designs other than the strictly triangular design. Trusses are also available for use in flooring, headers, or any other support.)

B. Top chord — Upper truss member

C. Bottom chord — Lower truss member

D. Tension web — Truss member connecting top and bottom chords in tension

E. Compression web — Truss member connecting top and bottom chords in compression

F. Glue-laminated timber — Timber made of thin pieces of lumber that have been glued together

(NOTE: Sometimes the lumber is sprung to desired shape before being glued.)

INFORMATION SHEET

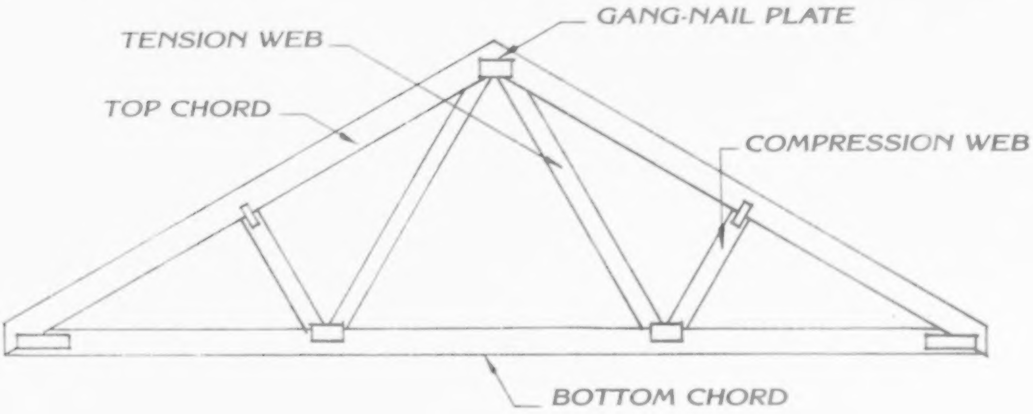
G. Gang-nail plate — Steel plate with a number of uniform nails that have been stamped out to protrude at right angles from the plate itself; used to strengthen wood-to-wood connections

H. Split ring — Steel ring with a tongue-and-grooved split in the band; used to strengthen wood-to-wood connections

I. Toothed ring — Corrugated and toothed thin steel ring; used to strengthen wood-to-wood connections

XII. Main parts of a truss (Figure 22)

FIGURE 22

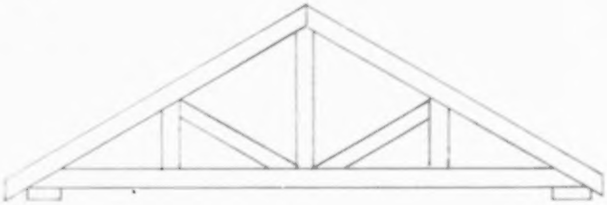


XIII. Types of trusses (Figures 23-31)

(NOTE: Trusses can be built to fit most situations. The trusses illustrated below and on the following pages are some of the most common types. Trusses may be constructed of solid-wood members, steel, glue-laminated timbers, or combinations of wood and steel. Some trusses are built with open webs, and some are built with solid frames and no webs.)

A. Standard Howe truss

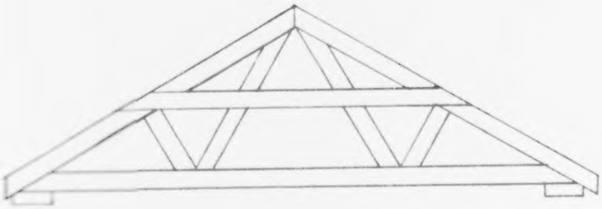
FIGURE 23



INFORMATION SHEET

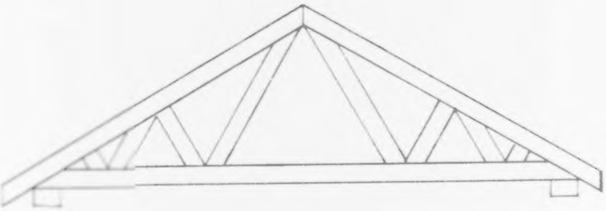
B. Hip-louver truss

FIGURE 24



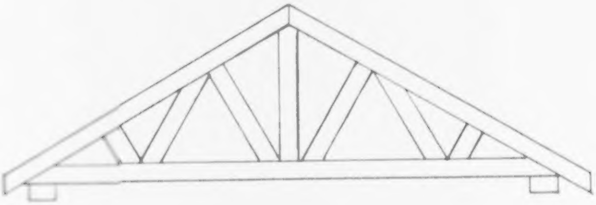
C. Double-W truss

FIGURE 25



D. Modified queen-post truss

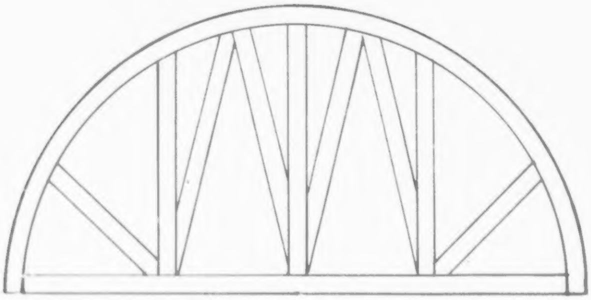
FIGURE 26



INFORMATION SHEET

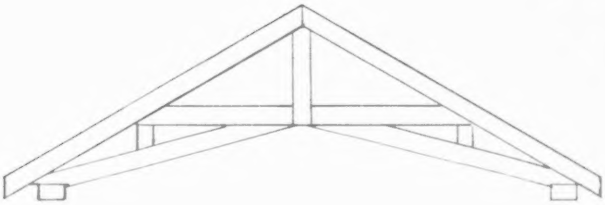
E. Bowstring truss

FIGURE 27



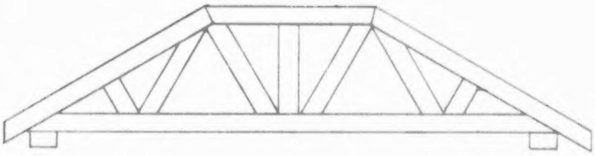
F. Scissors truss

FIGURE 28



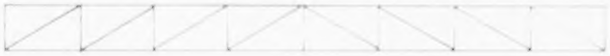
G. Hip truss

FIGURE 29



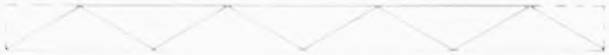
H. Howe flat truss

FIGURE 30



I. Warren flat truss

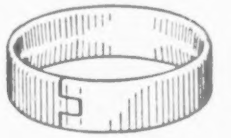
FIGURE 31



XIV. Hardware used in truss construction (Figures 32-39)

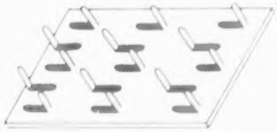
A. Split ring

FIGURE 32



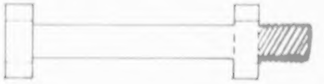
B. Gang-nail plate

FIGURE 33



C. Machine bolt

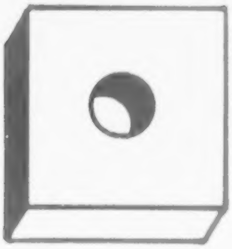
FIGURE 34



INFORMATION SHEET

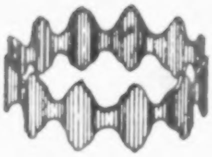
D. Plate washer

FIGURE 35



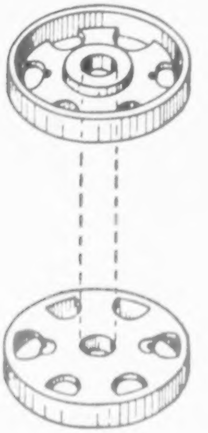
E. Toothed ring

FIGURE 36



F. Shear plate

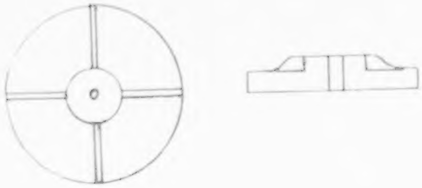
FIGURE 37



INFORMATION SHEET

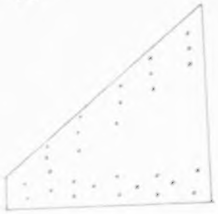
G. Malleable washer

FIGURE 38



H. Plywood gusset

FIGURE 39



XV. Types of vents used in roof construction

(NOTE: Most vents are backed with screen to prevent entry of birds and insects.)

A. Three-inch miniature round vent

(NOTE: This vent is often used to ventilate rafter space in structures with flat roofs.)

B. Four-inch miniature round vent

(NOTE: This vent is used in hard-to-reach places needing large ventilating area and is large enough to vent soffits.)

C. Ridge vent

(NOTE: This vent provides 18 square inches of net-free area per lineal foot when installed over a 1½-inch gap in the sheathing at the ridge.)

D. Roof vent

(NOTE: This vent is used to pull hot air out of the attic. It fits over an opening cut between the rafters.)

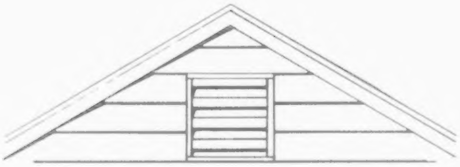
E. Square attic vent (See Figure 40)

(NOTE: This wood or metal vent is installed in the gable end and used to ventilate the attic area.)

INFORMATION SHEET

EXAMPLE:

FIGURE 40

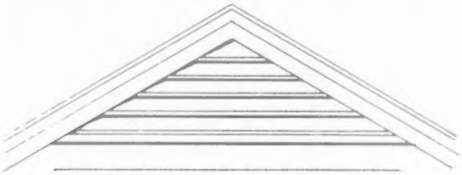


F. Triangular attic vent (Figure 41)

(NOTE: This triangular wood or metal attic vent is installed snugly under the roof gable to provide a large vent area at the highest point of the gable end.)

EXAMPLE:

FIGURE 41

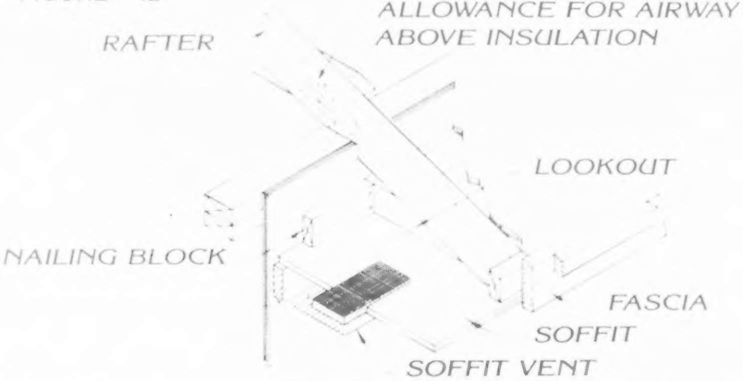


G. Soffit vent (Figure 42)

(NOTE: This vent replaces a portion of the soffit material to provide continuous ventilation at intervals along the length of the soffit. This type of vent may be made of a stamped or extruded vent strip, a perforated prefinished aluminum panel, or a perforated sheet of fiber materials.)

EXAMPLE:

FIGURE 42


ALLOWANCE FOR AIRWAY ABOVE INSULATION
RAFTER
LOOKOUT
NAILING BLOCK
FASCIA
SOFFIT
SOFFIT VENT

Figures 40 through 42 used with permission of Dover Publications, Inc., New York, from *How to Build a Wood-Frame House* by L.O. Anderson, 1970.

INFORMATION SHEET

XVI. Estimating materials needed to frame a roof

(NOTE: Approximately the same amount of framing material is required for either a gable or hip roof.)

A. Gable roof with rafters on 2-foot centers

1. Rafters

    a. Determine length of common rafters, including overhang (See Section VIII of the information sheet.)

    b. Determine number of common rafters needed by measuring length of one side of structure, rounding up to next foot, and dividing that number by 2

    c. Add six additional rafters: two for end rafters and four for barge rafters

    (NOTE: Barge rafters are usually one dimension narrower or thinner than common rafters.)

2. Ridgeboard

    (NOTE: The ridgeboard should be the next dimension wider than the rafter material.)

    a. Determine length of plate on one side of structure

    b. Add amount of projection over each gable end for a simple rectangular structure

B. Hip roof with rafters on 2-foot centers

1. Rafters

    a. Determine length of common rafters, including overhang (See Section VIII of the information sheet.)

    b. Determine length of hip rafters, including overhang (See Section IX of the information sheet.)

    (NOTE: Jack rafters are simply common rafters that have been shortened.)

    c. Determine number of common and jack rafters needed for a simple rectangular area by measuring length of one side of structure, rounding up to next foot, and dividing that number by 2

    d. Add two end rafters or four barge rafters where used

    e. Add one hip rafter for each corner

INFORMATION SHEET

2. Ridgeboard

   a. Measure length of structure

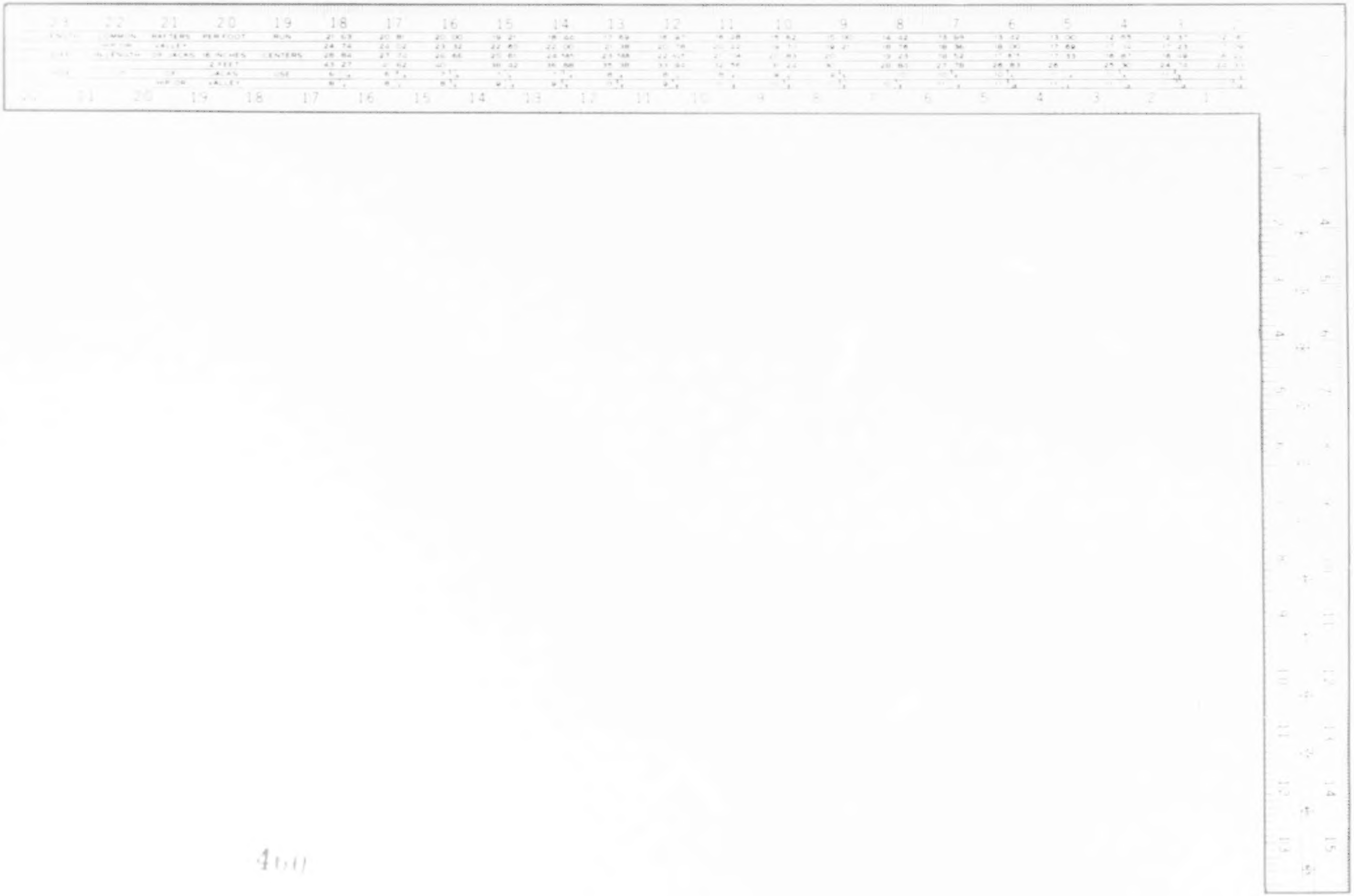
   b. Measure width of structure

   c. Subtract width from length

   d. Add thickness of ridgeboard to remainder to find actual ridgeboard length

ROOF FRAMING
UNIT III

STUDENT SUPPLEMENT #1 — THE FRAMING SQUARE


LENGTH COMMON RAFTERS PER FOOT RUN
HIP OR VALLEY
DIFF IN LENGTH OF JACKS 16 INCHES CENTERS
2 FEET
SIDE CUT OF JACKS USE
HIP OR VALLEY

ROOF FRAMING
UNIT III

ASSIGNMENT SHEET #1 — ESTIMATE MATERIALS NEEDED TO FRAME A ROOF

NAME ______________________________ SCORE ______________

Accurate roof framing is a difficult task that requires skill and care. One of the skills required is the ability to accurately compute the lengths of framing members and to estimate the materials needed.

Using the information sheet, a framing square, and the illustrations that follow, calculate the materials needed for the roof members listed. Write your answers in the blanks and show your work.

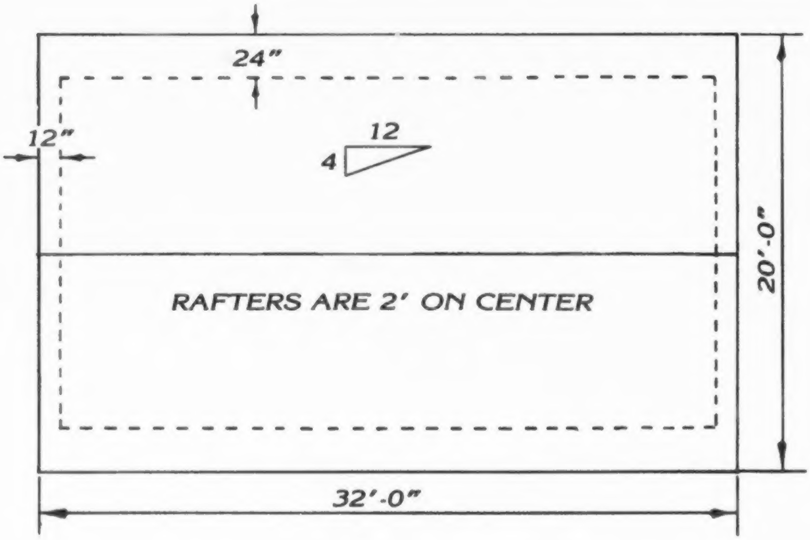
Part I — Gable roof

A. Common-rafter length = ______________________________

B. Ridgeboard length = ______________________________

C. Total 2×6 material needed = ______________________________

D. Total 2×8 material needed = ______________________________



ASSIGNMENT SHEET #1

Part II — Hip roof

A. Common-rafter length =____________________________

B. Hip-rafter length =____________________________

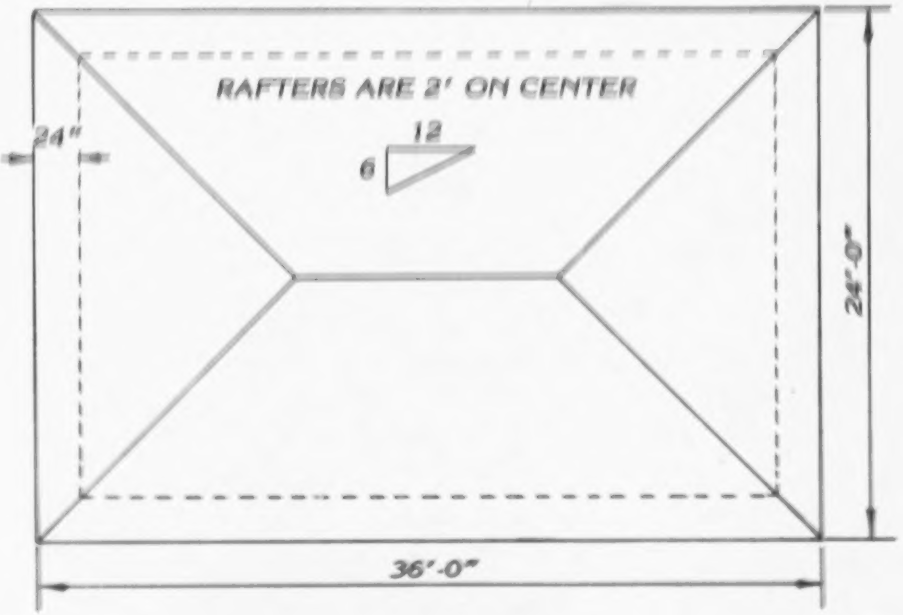
C. Ridgeboard length =____________________________

D. Length of each jack rafter

1. ____________________________
2. ____________________________
3. ____________________________
4. ____________________________
5. ____________________________

E. Total 2×6 material needed =____________________________

F. Total 2×8 material needed =____________________________


RAFTERS ARE 2' ON CENTER
12
6
24"
24'-0"
36'-0"

ROOF FRAMING
UNIT III

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1
(NOTE: Because estimating answers will vary considerably, answers should be evaluated to the satisfaction of the instructor.)

Part I

A. 10'-6 1/2"

B. 32'-0"

C. Thirty-eight 2"× 6"×12'

D. Two 2"× 8"×16'

Part II

A. 13'-5"

B. 18'-0"

C. 12'-0"

D. 1. 11'-2 1/8"
   2. 8'-11 1/4"
   3. 6'-8 3/8"
   4. 4'-5 1/2"
   5. 2'-2 5/8"

E. 1. Nine 2"× 6"×12'
   2. Twenty 2"× 6"×14'
   3. Eleven 2"× 6"×18'

F. One 2"× 8"× 12'

ROOF FRAMING
UNIT III

JOB SHEET #1 — LAY OUT RAFTER LOCATIONS ON THE TOP PLATE AND RIDGEBOARD ON 2-FOOT CENTERS

I. Tools and materials

- A. Folding rule or steel tape
- B. Framing square
- C. Completed wall sections with double top plate
- D. Ridgeboard material
- E. Pencil

II. Procedure

(NOTE: This procedure may be done while laying out ceiling joists. For simplification, ceiling-joist markings are not shown in illustrations.)

A. Gable roof (with box cornice)

1. Cut ridgeboard to correct length, allowing for barge rafter at each end if used

2. Lay out rafter locations on double top plate

    a. Begin at one end of top plate and locate first rafter flush with end of top plate

    b. Use steel tape with the "0" end held against the left outside end of wall to mark 2-foot locations on top plate; mark an "R" to the right of each mark (See Figure 43)

    c. Set last rafter flush with outside of opposite end of structure

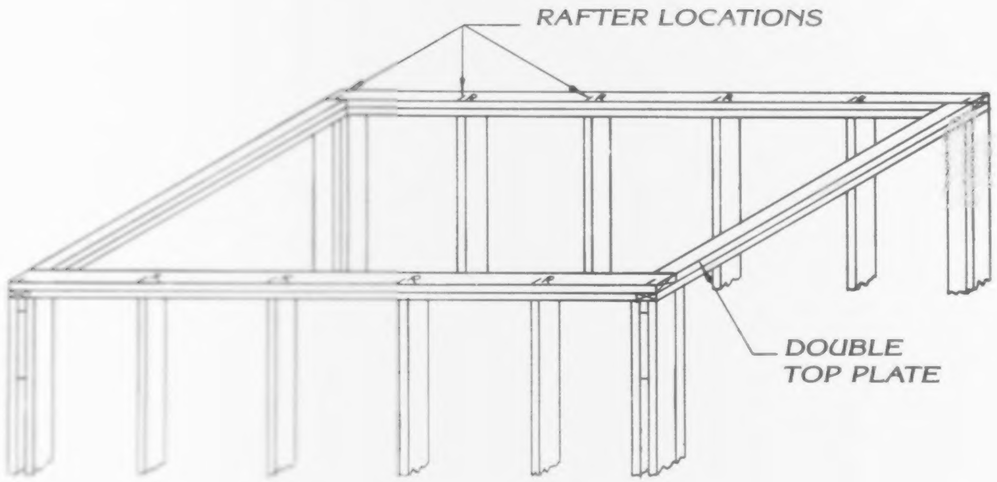
    (NOTE: The spacing between the last two rafters may be less than—but not more than—2 feet.)

    d. Use framing square to square a line across top plate at each 2-foot mark

    e. Repeat the marking process on opposite top plate, being sure to start from same end of structure; work from right to left (See Figure 43)

JOB SHEET #1

FIGURE 43



3. Lay out ridgeboard

   a. Place ridgeboard on edge on top of top plate with required projection at each end

   b. Mark ridgeboard on both sides to correspond to marks on top plate

   c. Use framing square to square lines across face of ridgeboard at each mark, and write an "R" to the right of each mark as for the top plate

B. Hip roof

1. Cut ridgeboard to correct length

   a. Measure length of sidewall between ends of plate

   b. Measure length of end wall from outside of plates

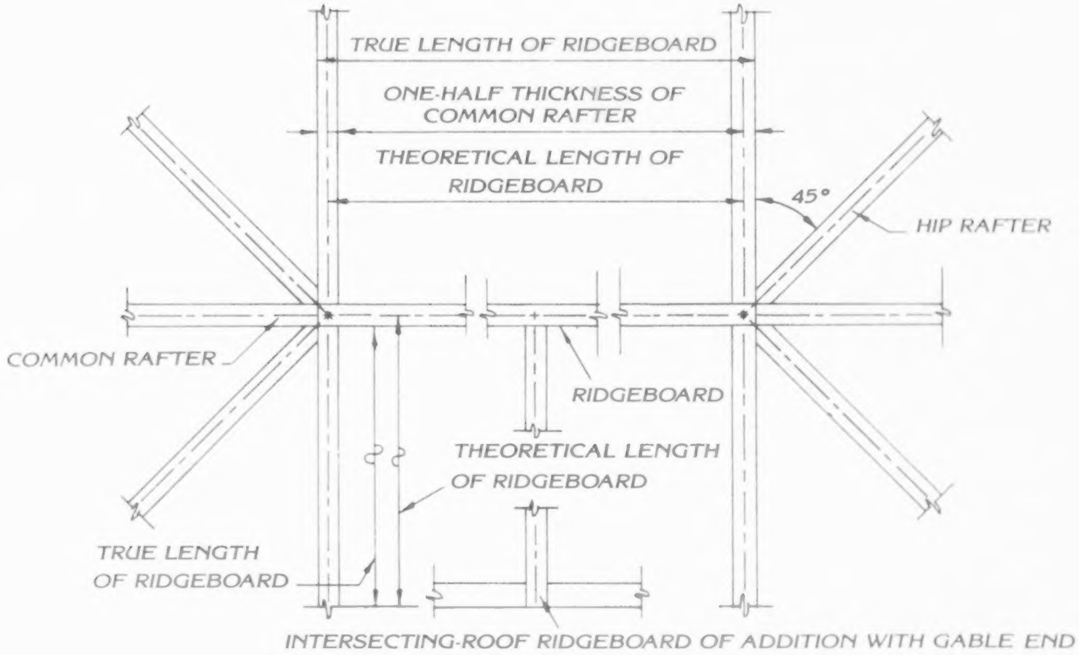
   c. Subtract length of end wall from length of sidewall

   d. Add thickness of ridgeboard to difference found in step c

   e. Measure and cut ridgeboard to required length (See Figure 44)

JOB SHEET #1

FIGURE 44


TRUE LENGTH OF RIDGEBOARD
ONE-HALF THICKNESS OF COMMON RAFTER
THEORETICAL LENGTH OF RIDGEBOARD
45°
HIP RAFTER
COMMON RAFTER
RIDGEBOARD
THEORETICAL LENGTH OF RIDGEBOARD
TRUE LENGTH OF RIDGEBOARD
INTERSECTING-ROOF RIDGEBOARD OF ADDITION WITH GABLE END

2. Lay out rafter locations on top plate

   a. Measure one-half the width of the structure from the end on top plate of one sidewall

      (NOTE: This locates the center of the first rafter.)

   b. Mark one-half the thickness of rafter on either side of this mark

   c. Space all other rafters, both commons and jacks, from this rafter, and mark their locations by squaring a line across top plate

   d. Mark an "R" on one side of line to indicate side on which rafter is to be placed

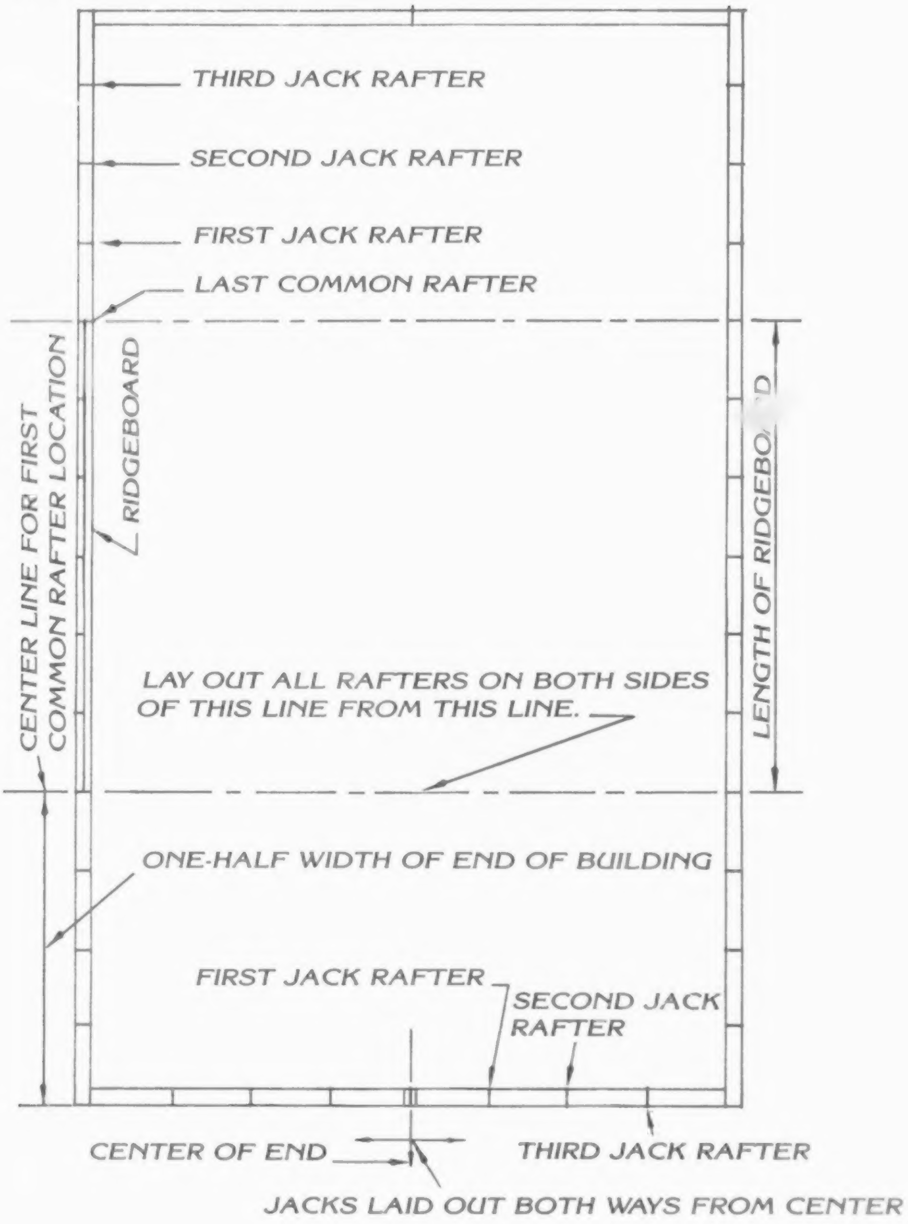
   e. Repeat steps a through d for opposite side

   f. Lay out end wall, beginning at center and working both ways

   g. Transfer top-plate markings to the ridgeboard by holding one edge on top plate with one end flush with outside mark for first common rafter and marking each location on both sides of ridgeboard (See Figure 45)

JOB SHEET #1

FIGURE 45


THIRD JACK RAFTER
SECOND JACK RAFTER
FIRST JACK RAFTER
LAST COMMON RAFTER
CENTER LINE FOR FIRST COMMON RAFTER LOCATION
RIDGEBOARD
LENGTH OF RIDGEBOARD
LAY OUT ALL RAFTERS ON BOTH SIDES OF THIS LINE FROM THIS LINE.
ONE-HALF WIDTH OF END OF BUILDING
FIRST JACK RAFTER
SECOND JACK RAFTER
CENTER OF END
THIRD JACK RAFTER
JACKS LAID OUT BOTH WAYS FROM CENTER

C. Clean up area and put away tools and materials

ROOF FRAMING
UNIT III

JOB SHEET #2 — LAY OUT, CUT, AND ERECT RAFTERS

I. Tools and materials

- A. Framing square
- B. 100-foot tape
- C. Folding rule or steel tape
- D. Claw hammer
- E. Power handsaw and extension cord
- F. Handsaw
- G. Rafter tables booklet
- H. Pencil
- I. Chalk line
- J. String line
- K. Rafter materials
- L. Ridgeboard material
- M. Nails
    - 1. 16d box nails
    - 2. 8d box nails

II. Procedure

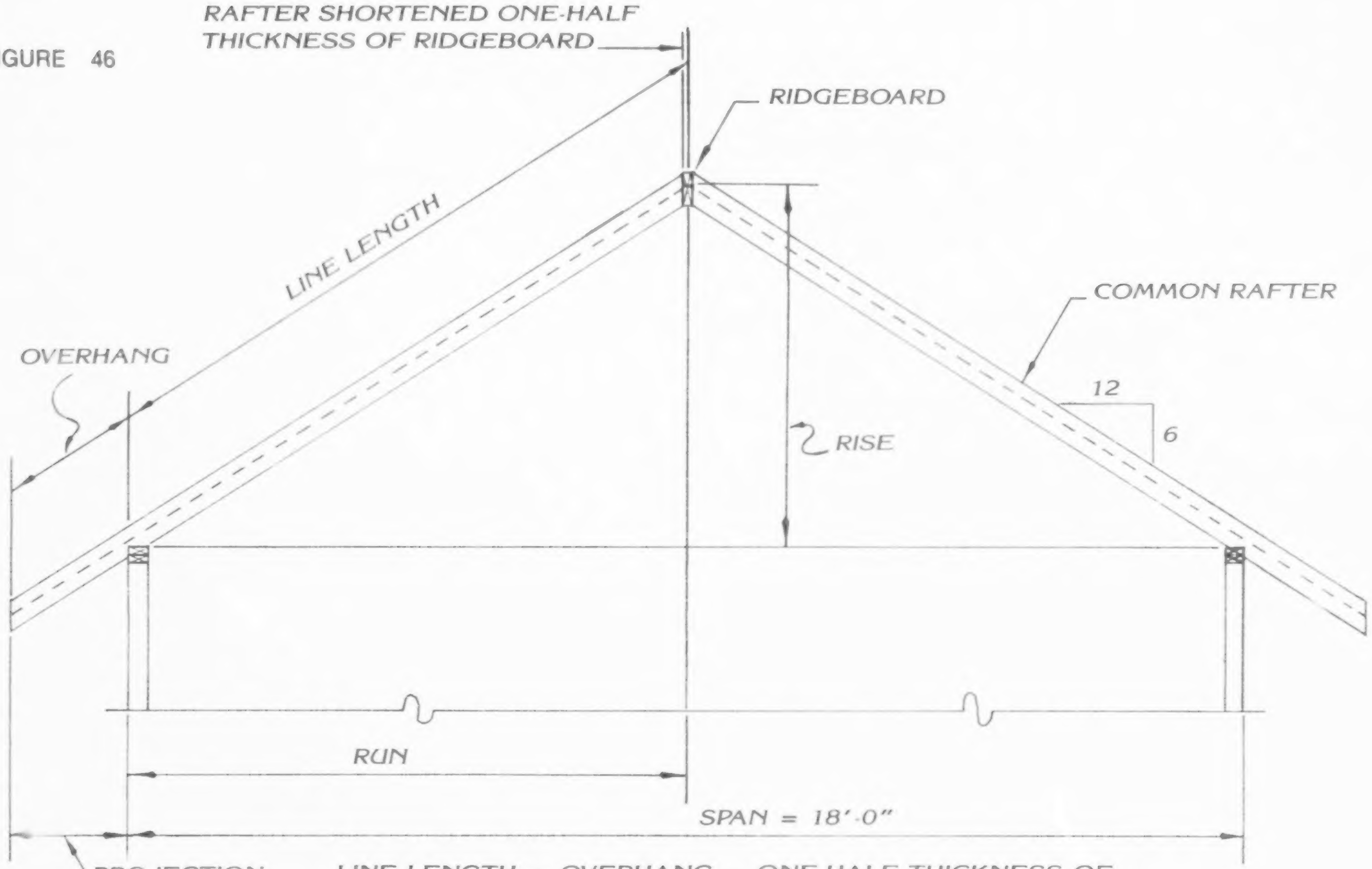
(NOTE: The procedures described in this job sheet require care and practice. To illustrate calculations, an example will be used throughout the job sheet. The example consists of a structure with an 18-foot span and a 6 in 12 slope. Your instructor may have you construct these rafters for practice or apply the procedures to other rafters.)

- A. Lay out and cut a pattern for each type of rafter needed
    - 1. Common rafter
        - a. Calculate length of rafter (See Figure 46)

          (NOTE: This length is the center-line length of the rafter. Use framing square or rafter table. See Tables 1 and 2.)

JOB SHEET #2

FIGURE 46


RAFTER SHORTENED ONE-HALF THICKNESS OF RIDGEBOARD
RIDGEBOARD
LINE LENGTH
COMMON RAFTER
OVERHANG
12
6
RISE
RUN
SPAN = 18'-0"
PROJECTION

LINE LENGTH + OVERHANG − ONE-HALF THICKNESS OF RIDGEBOARD = TRUE COMMON RAFTER LENGTH

JOB SHEET #2

TABLE 1

4-INCH RISE PER FOOT

JACK RAFTER

Spaced In.	Length Ft.	Length In.
1..		1
2..		2⅛
3..		3⅛
4..		4¼
5..		5¼
6..		6⅜
7..		7⅜
8..		8⅜
9..		9½
10..		10½
11..		11⅝
12..	1	0⅝
13..		1¾
14..		2¾
15..		3¾
16..		4⅞
17..		5⅞
18..		7
19..		8
20..		9⅛
21..		10⅛
22..		11¼
23..	2	0¼
24..		1¼
25..		2⅜
26..		3⅜
27..		4½
28..		5½
29..		6⅝
30..		7⅝
31..		8⅝
32..		9¾
33..		10¾
34..		11⅞
35..	3	0⅞
36..		2
37..		3
38..		4
39..		5⅛
40..		6⅛
41..		7¼
42..		8¼
43..		9⅜
44..		10⅜
45..		11⅜
46..	4	0½
47..		1½
48..		2⅝

EXPLANATION

Common Rafter

Width of building............31'4¾"
Find length of Common Rafter.

Answer:

Under **Span, ft.** find 31' = 16' 4"
" " In. " 4¾" = 2⅛"

Total length Common Rft. 16' 6⅛"

When rafters overhang, add both overhangs to width of building. Use total span as before.

To get length of rafter by its run: doubling the run gives the span. Proceed as before.

Tables give full length. Allow for half thickness of ridge.

Spans over 50', as 60', add lengths of 50' & 10' spans together.

Hip Rafter

If common rafter span is 31'4¾", Hip rafter is 22'9¾" long. Measure length of Hip on center of top edge. If Hip is unbacked (top edge square), see Index. If edge is backed (beveled), see Index.

Allow for half thickness of ridge.

Jack Rafters

Spaced 28" apart are 2'5½" different in length. Measure length on center of top edge. Cut short equal to half thickness of hip.

CUTS FOR STEEL SQUARE.

The first figure is always the cut.

Common Rafter
Plumb 4 - 12
Level. 12 4

Hip Rafter
Plumb 4 - 17
Level. 17 - 4
Side.. 8¾ - 8½
Backing 4 - 17⅜
Set bevel to last named.

Jack Rafter
Plumb 4 - 12
Level. 12 4
Side.. 12⅝ - 12

Purlin Rafter Roof Sheathing
Plumb 4 - 12⅝
Cross. 12 - 12⅝

Valley Shingles
Cross. 12 - 12⅝
Set bevel on butt end.

Mitre-Box Cuts for Gable Moulds
Plumb 4 - 12
Mitre. 12⅝ - 12

Bisection of
4 - 12 = 3⅞ - 24

For full explanation see Index.

COMMON RAFTER

Span Ft.	Length Ft.	Length In.	Span In.	Lgth. In.
1..		6⅜	¼	⅛
2..	1	0⅝	½	¼
3..	1	7	¾	⅜
4..	2	1¼	1	½
5..	2	7⅝	¼	⅝
6..	3	2	½	¾
7..	3	8¼	¾	⅞
8..	4	2⅝	2	1
9..	4	8⅞	¼	⅛
10..	5	3¼	½	⅜
11..	5	9⅝	¾	½
12..	6	3⅞	3	⅝
13..	6	10¼	¼	¾
14..	7	4½	½	⅞
15..	7	10⅞	¾	2
16..	8	5¼	4	⅛
17..	8	11½	¼	¼
18..	9	5⅞	½	⅜
19..	10	0⅛	¾	½
20..	10	6½	5	⅝
21..	11	0⅞	¼	¾
22..	11	7⅛	½	⅞
23..	12	1½	¾	3
24..	12	7¾	6	⅛
25..	13	2⅛	¼	¼
26..	13	8½	½	⅜
27..	14	2¾	¾	½
28..	14	9⅛	7	¾
29..	15	3⅜	¼	⅞
30..	15	9¾	½	4
31..	16	4	¾	⅛
32..	16	10⅜	8	¼
33..	17	4¾	¼	⅜
34..	17	11	½	½
35..	18	5⅜	¾	⅝
36..	18	11⅝	9	¾
37..	19	6	¼	⅞
38..	20	0⅜	½	5
39..	20	6⅝	¾	⅛
40..	21	1	10	¼
41..	21	7¼	¼	⅜
42..	22	1⅝	½	½
43..	22	8	¾	⅝
44..	23	2¼	11	¾
45..	23	8⅝	¼	⅞
46..	24	3	½	6
47..	24	9¼	¾	¼
48..	25	3⅝	12	⅜
49..	25	9⅞		
50..	26	4¼		

HIP OR VALLEY RAFTER

Span Ft.	Length Ft.	Length In.	Span In.	Lgth. In.
1..		8¾	¼	⅛
2..	1	5⅜	½	⅜
3..	2	2⅛	¾	½
4..	2	10⅞	1	¾
5..	3	7⅝	¼	⅞
6..	4	4¼	½	1⅛
7..	5	1	¾	¼
8..	5	9¾	2	½
9..	6	6½	¼	⅝
10..	7	3⅛	½	⅞
11..	7	11⅞	¾	2
12..	8	8⅝	3	⅛
13..	9	5⅜	¼	⅜
14..	10	2	½	½
15..	10	10¾	¾	¾
16..	11	7½	4	⅞
17..	12	4¼	¼	3⅛
18..	13	0⅞	½	¼
19..	13	9⅝	¾	½
20..	14	6⅜	5	⅝
21..	15	3⅛	¼	⅞
22..	15	11¾	½	4
23..	16	8½	¾	⅛
24..	17	5¼	6	⅜
25..	18	2	¼	½
26..	18	10⅝	½	¾
27..	19	7⅜	¾	⅞
28..	20	4⅛	7	5⅛
29..	21	0⅞	¼	¼
30..	21	9½	½	½
31..	22	6¼	¾	⅝
32..	23	3	8	¾
33..	23	11¾	¼	6
34..	24	8⅜	½	⅛
35..	25	5⅛	¾	⅜
36..	26	1⅞	9	½
37..	26	10½	¼	¾
38..	27	7¼	½	⅞
39..	28	4	¾	7⅛
40..	29	0¾	10	¼
41..	29	9⅜	¼	½
42..	30	6⅛	½	⅝
43..	31	2⅞	¾	¾
44..	31	11⅝	11	8
45..	32	8¼	¼	⅛
46	33	5	½	⅜
47..	34	1¾	¾	½
48..	34	10½	12	¾
49..	35	7⅛		
50..	36	3⅞		

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JOB SHEET #2

TABLE 2

JACK RAFTER

Spaced In.	Length Ft. In.
1	1⅛
2	2¼
3	3⅜
4	4½
5	5⅝
6	6¾
7	7⅞
8	9
9	10⅛
10	11⅛
11	1 0¼
12	1⅜
13	2½
14	3⅝
15	4¾
16	5⅞
17	7
18	8⅛
19	9¼
20	10⅜
21	11½
22	2..0⅝
23	1¾
24	2⅞
25	4
26	5⅛
27	6⅛
28	7¼
29	8⅜
30	9½
31	10⅝
32	11¾
33	3..0⅞
34	2
35	3⅛
36	4¼
37	5⅜
38	6½
39	7⅝
40	8¾
41	9⅞
42	11
43	4..0⅛
44	1¼
45	2¼
46	3⅜
47	4½
48	5⅝

6-INCH
RISE PER FOOT

EXPLANATION

Common Rafter

Width of building...........24′6¼″
Find length of Common Rafter.

Answer:

Under **Span, ft.** find 24′ = 13′ 5″
" " **in.** " 6¼″ = 3½″

Total length Common Rft. 13′ 8½″

When rafters overhang, add both overhangs to width of building. Use total span as before.

To get length of rafter by its run: doubling the run gives the span. Proceed as before.

Tables give full length. Allow for half thickness of ridge.

Spans over 50′, as 60′, add lengths of 50′ & 10′ spans together.

Hip Rafter

If common rafter span is 24′6¼″, Hip rafter is 18′4⅝″ long. Measure length of Hip on center of top edge. If Hip is unbacked (top edge square), see Index. If edge is backed (beveled), see Index.

Allow for half thickness of ridge.

Jack Rafters

Spaced 24″ apart are 2′2⅞″ different in length. Measure length on center of top edge. Cut short equal to half thickness of hip.

CUTS FOR STEEL SQUARE.

The first figure is always the cut.

Common Rafter

Plumb 6 - 12
Level. 12 - 6

Hip Rafter

Plumb 6 - 17
Level. 17 - 6
Side.. 9 - 8½
Backing 6 - 18
Set bevel to last named.

Jack Rafter

Plumb 6 - 12
Level. 12 - 6
Side.. 13⅜ - 12

Purlin Rafter Roof Sheathing

Plumb 6 - 13⅜
Cross. 12 - 13⅜

Valley Shingles

Cross. 12 - 13⅜
Set bevel on butt end.

Mitre-Box Cuts for Gable Moulds

Plumb 6 - 12
Mitre. 13⅜ - 12

Bisection of
6 - 12=5⅝ - 24

For full explanation see Index.

COMMON RAFTER

Span Ft.	Length Ft. In.	Span In.	Lgth. In.
1	. 6¼	¼	⅛
2	1. 1⅛	½	¼
3	1. 8⅛	¾	⅜
4	2. 2⅞	1	½
5	2. 9½	¼	¾
6	3. 4¼	½	⅞
7	3. 11	¾	1
8	4. 5⅝	2	⅛
9	5. 0⅜	¼	¼
10	5. 7⅛	½	⅜
11	6. 1¾	¾	½
12	6. 8½	3	⅝
13	7. 3¼	¼	⅞
14	7. 9⅞	½	2
15	8. 4⅝	¾	⅛
16	8. 11⅜	4	¼
17	9. 6	¼	⅜
18	10. 0¾	½	½
19	10. 7½	¾	⅝
20	11. 2⅛	5	¾
21	11. 8⅞	¼	⅞
22	12. 3⅝	½	3⅛
23	12. 10¼	¾	¼
24	13. 5	6	⅜
25	13. 11¾	¼	½
26	14. 6⅜	½	⅝
27	15. 1⅛	¾	¾
28	15. 7⅞	7	⅞
29	16. 2½	¼	4
30	16. 9¼	½	¼
31	17. 4	¾	⅜
32	17. 10⅝	8	½
33	18. 5⅜	¼	⅝
34	19. 0⅛	½	¾
35	19. 6¾	¾	⅞
36	20. 1½	9	5
37	20. 8¼	¼	⅛
38	21. 2⅞	½	¼
39	21. 9⅝	¾	½
40	22. 4⅜	10	⅝
41	22. 11	¼	¾
42	23. 5¾	½	⅞
43	24. 0½	¾	6
44	24. 7⅛	11	⅛
45	25. 1⅞	¼	¼
46	25. 8⅝	½	⅜
47	26. 3¼	¾	½
48	26. 10	12	¾
49	27. 4¾		
50	27. 11⅜		

HIP or VALLEY RAFTER

Span Ft.	Length Ft. In.	Span In.	Lgth. In.
1	. 9	¼	¼
2	1. 6	½	⅜
3	2. 3	¾	⅝
4	3. 0	1	¾
5	3. 9	¼	1
6	4. 6	½	⅛
7	5. 3	¾	¼
8	6. 0	2	½
9	6. 9	¼	⅝
10	7. 6	½	⅞
11	8. 3	¾	2
12	9. 0	3	¼
13	9. 9	¼	⅜
14	10. 6	½	⅝
15	11. 3	¾	¾
16	12. 0	4	3
17	12. 9	¼	⅛
18	13. 6	½	⅜
19	14. 3	¾	½
20	15. 0	5	¾
21	15. 9	¼	⅞
22	16. 6	½	4⅛
23	17. 3	¾	¼
24	18. 0	6	½
25	18. 9	¼	⅝
26	19. 6	½	⅞
27	20. 3	¾	5
28	21. 0	7	¼
29	21. 9	¼	⅜
30	22. 6	½	⅝
31	23. 3	¾	¾
32	24. 0	8	6
33	24. 9	¼	⅛
34	25. 6	½	⅜
35	26. 3	¾	½
36	27. 0	9	¾
37	27. 9	¼	⅞
38	28. 6	½	7⅛
39	29. 3	¾	¼
40	30. 0	10	½
41	30. 9	¼	⅝
42	31. 6	½	⅞
43	32. 3	¾	8
44	33. 0	11	¼
45	33. 9	¼	⅜
46	34. 6	½	⅝
47	35. 3	¾	¾
48	36. 0	12	9
49	36. 9		
50	37. 6		

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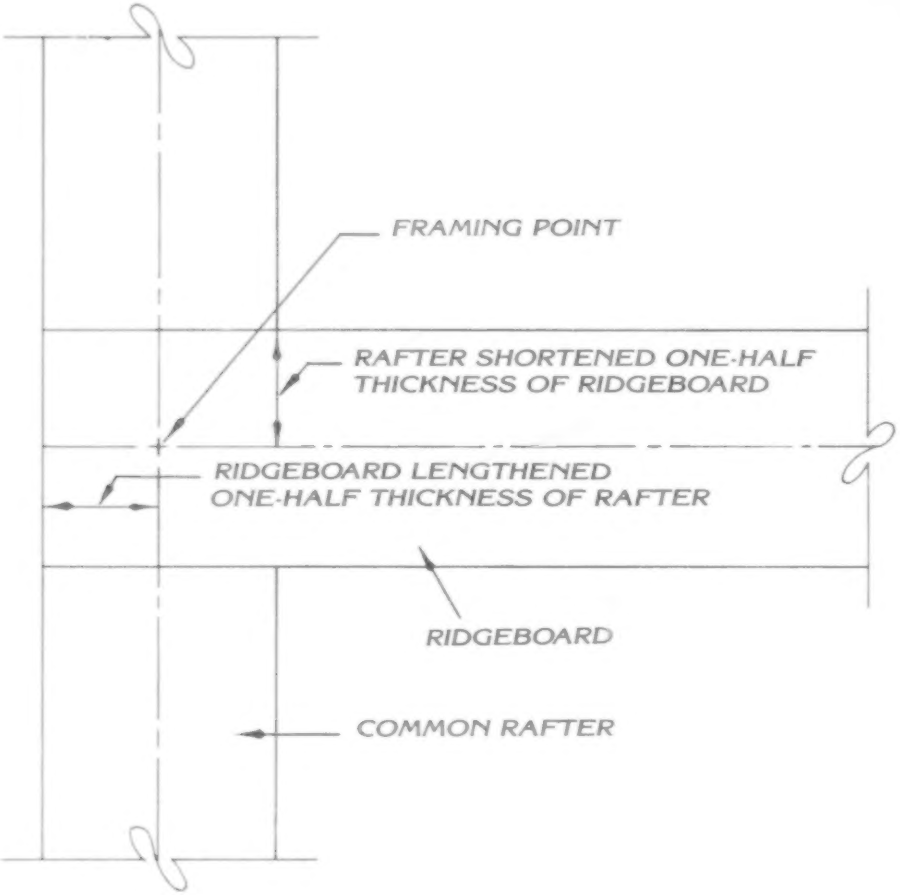
JOB SHEET #2

b. Shorten length of rafter by one-half thickness of ridgeboard (Figure 47)

FIGURE 47


FRAMING POINT
RAFTER SHORTENED ONE-HALF THICKNESS OF RIDGEBOARD
RIDGEBOARD LENGTHENED ONE-HALF THICKNESS OF RAFTER
RIDGEBOARD
COMMON RAFTER

c. Lay a 2×6, sufficient in length for a common rafter including overhang, across two sawhorses

d. Mark top end or plumb cut

1) Determine crown edge of rafter

2) Make sure toe of plumb cut is on crown edge

3) Place framing square across face of rafter near one end with blade running lengthwise with rafter and tongue running across face of rafter

JOB SHEET #2

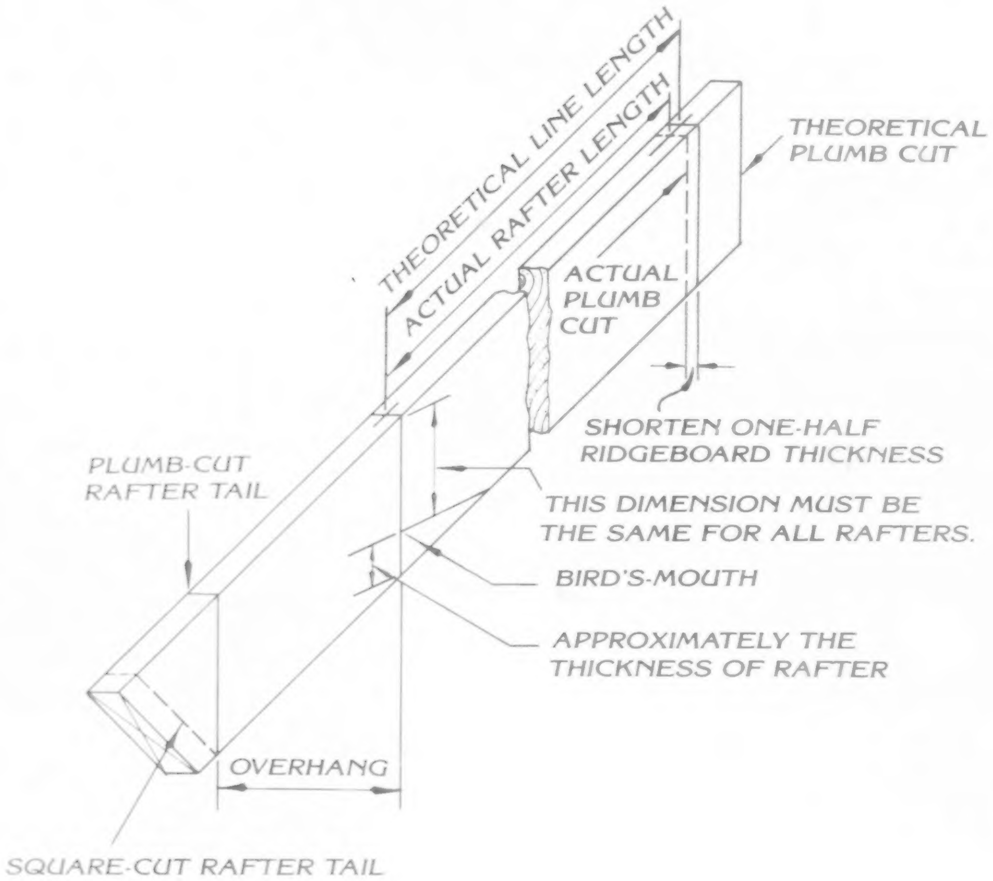
4) Locate inches of rise per foot of run on tongue of framing square

5) Locate inches of run on blade of framing square

(NOTE: For common rafter, the run will always be 12 inches.)

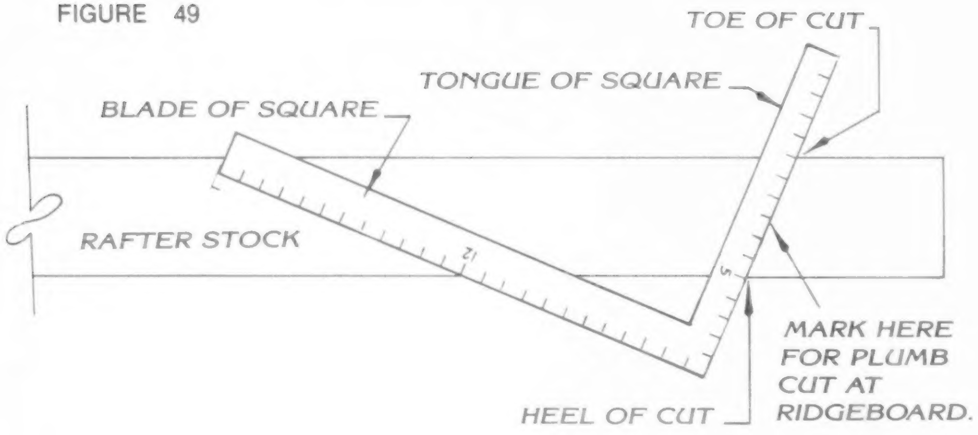
6) Mark rafter on outside edge of framing-square tongue (Figures 48 and 49)

FIGURE 48


THEORETICAL LINE LENGTH
ACTUAL RAFTER LENGTH
THEORETICAL PLUMB CUT
ACTUAL PLUMB CUT
SHORTEN ONE-HALF RIDGEBOARD THICKNESS
PLUMB-CUT RAFTER TAIL
THIS DIMENSION MUST BE THE SAME FOR ALL RAFTERS.
BIRD'S-MOUTH
APPROXIMATELY THE THICKNESS OF RAFTER
OVERHANG
SQUARE-CUT RAFTER TAIL

JOB SHEET #2

FIGURE 49


TOE OF CUT
TONGUE OF SQUARE
BLADE OF SQUARE
RAFTER STOCK
12
5
MARK HERE FOR PLUMB CUT AT RIDGEBOARD.
HEEL OF CUT

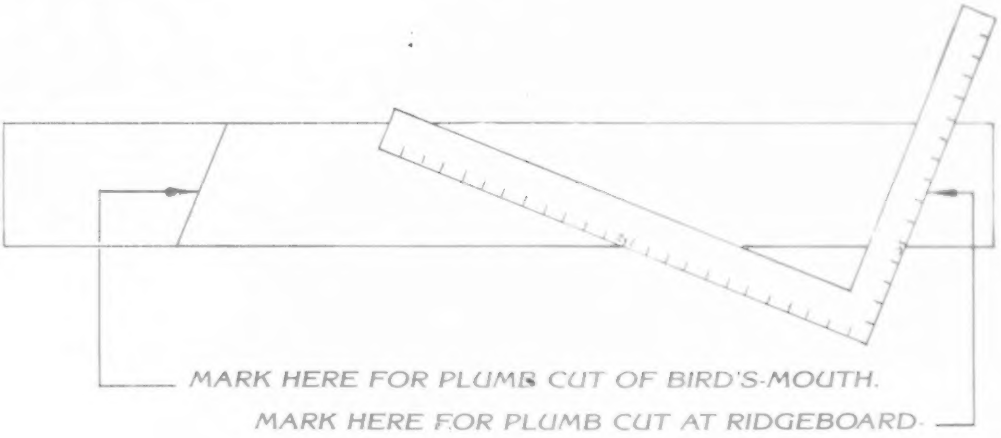
7) Using 18′-0″ span of structure, determine from rafter table line length of rafter

e. Measure length of rafter on top edge from toe of plumb cut

f. Place framing square in position to mark plumb cut for bird's-mouth, and mark 1½-inch line (Figure 50)

(NOTE: Adjustment may need to be made for high-pitch roofs.)

FIGURE 50

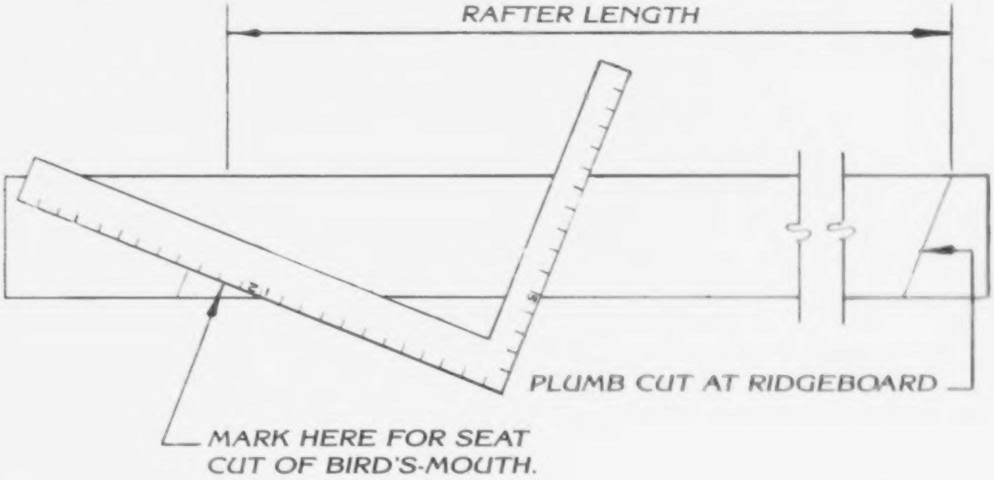

MARK HERE FOR PLUMB CUT OF BIRD'S-MOUTH.
MARK HERE FOR PLUMB CUT AT RIDGEBOARD.

JOB SHEET #2

g. Place framing square in position to mark seat cut for bird's-mouth, and mark (Figure 51)

(NOTE: Bird's-mouth cut should not exceed more than one-third of material.)

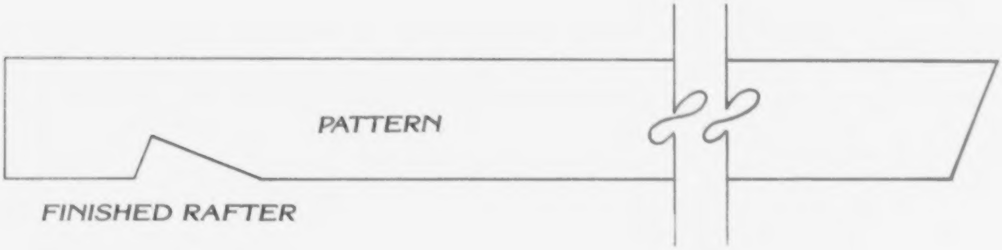
FIGURE 51


RAFTER LENGTH
PLUMB CUT AT RIDGEBOARD
MARK HERE FOR SEAT CUT OF BIRD'S-MOUTH.

h. Cut rafter on lines marked

(NOTE: Cut only part of the bird's-mouth with the power saw; finish the cut with a handsaw. The finished rafter should look like the one in Figure 52.Care must be taken to get a very accurate cut on the first rafter, as it will be used as a pattern for the remaining common rafters. Write "Pattern" on both sides. See Figure 52. When using pattern rafter, keep top flush at bird's-mouth when marking.)

FIGURE 52


PATTERN
FINISHED RAFTER

JOB SHEET #2

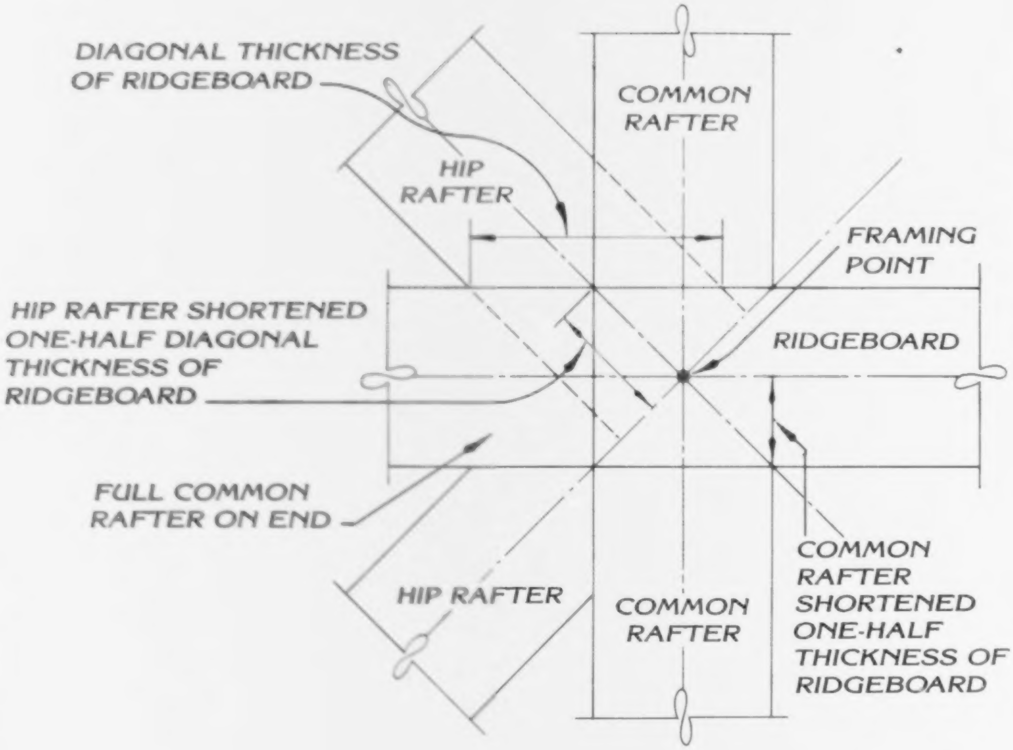
2. Hip or valley rafter

   a. Determine length of rafters

      (NOTE: Rafter length can be determined by measurement; this length is the center-line length of rafter.)

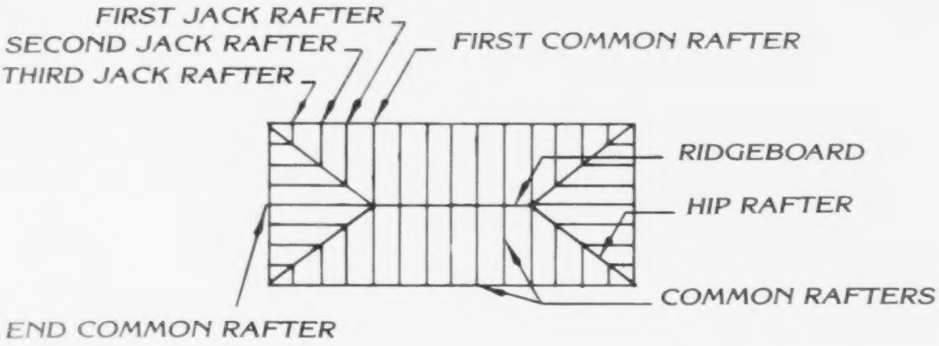
   b. Shorten length of rafter by one-half the diagonal thickness of ridgeboard to allow for ridgeboard (See Figures 53 and 54)

FIGURE 53


DIAGONAL THICKNESS OF RIDGEBOARD
COMMON RAFTER
HIP RAFTER
FRAMING POINT
HIP RAFTER SHORTENED ONE-HALF DIAGONAL THICKNESS OF RIDGEBOARD
RIDGEBOARD
FULL COMMON RAFTER ON END
HIP RAFTER
COMMON RAFTER
COMMON RAFTER SHORTENED ONE-HALF THICKNESS OF RIDGEBOARD

JOB SHEET #2

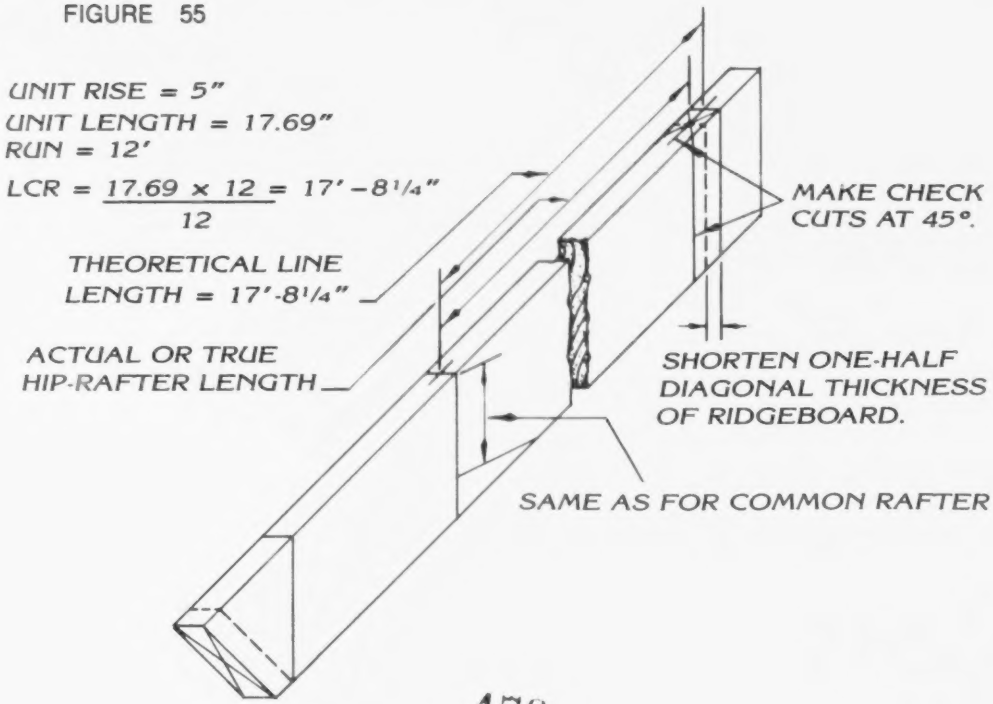
FIGURE 54


FIRST JACK RAFTER
SECOND JACK RAFTER
THIRD JACK RAFTER
FIRST COMMON RAFTER
RIDGEBOARD
HIP RAFTER
COMMON RAFTERS
END COMMON RAFTER

c. Lay a 2×8, sufficient in length for a hip rafter including overhang, across two sawhorses; lay out and cut as for common rafter (Figures 55 and 56)

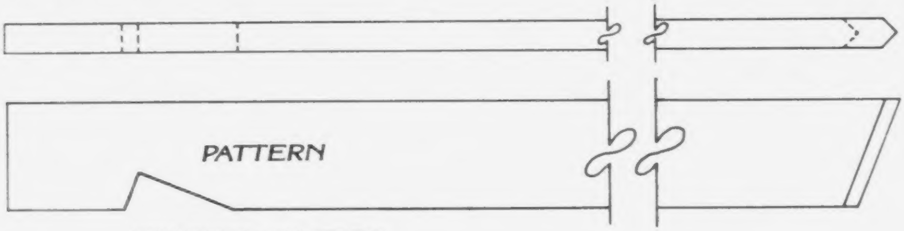
(NOTE: The inches of run on the blade of the framing square for a hip rafter will always be seventeen.)

FIGURE 55


UNIT RISE = 5"
UNIT LENGTH = 17.69"
RUN = 12'
LCR = 17.69 × 12 / 12 = 17'-8¼"
THEORETICAL LINE LENGTH = 17'-8¼"
ACTUAL OR TRUE HIP-RAFTER LENGTH
MAKE CHECK CUTS AT 45°.
SHORTEN ONE-HALF DIAGONAL THICKNESS OF RIDGEBOARD.
SAME AS FOR COMMON RAFTER

JOB SHEET #2

FIGURE 56



FINISHED RAFTER

d. Cut valley rafters as for hip rafters except that bird's-mouth will be raised 3/8-inch

3. Hip or valley jack rafters on 2-foot centers

a. Determine length of first jack rafter

(NOTE: Remember that the figure read from the framing square is the difference in length of jack rafters from the common rafter.)

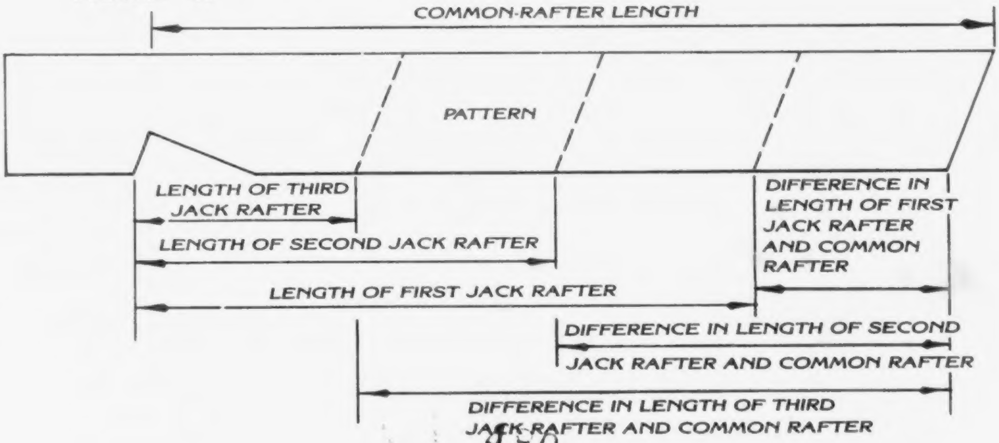
b. Use pattern for common rafters to mark bird's-mouth

(NOTE: Drop the hip 3/8 inch to align with common rafter and raise 3/8 inch on valley rafters.)

c. Measure length of first jack rafter from plumb cut of bird's-mouth (Figures 57 and 58)

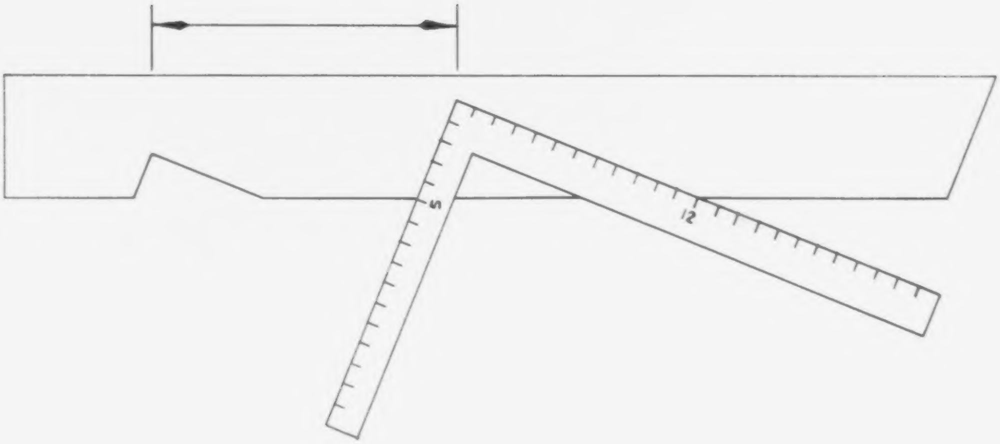
(NOTE: Remember that this length is the theoretical length of the jack rafter and it must be shortened one-half the diagonal thickness of the rafter.)

FIGURE 57


COMMON-RAFTER LENGTH
PATTERN
LENGTH OF THIRD JACK RAFTER
LENGTH OF SECOND JACK RAFTER
LENGTH OF FIRST JACK RAFTER
DIFFERENCE IN LENGTH OF FIRST JACK RAFTER AND COMMON RAFTER
DIFFERENCE IN LENGTH OF SECOND JACK RAFTER AND COMMON RAFTER
DIFFERENCE IN LENGTH OF THIRD JACK-RAFTER AND COMMON RAFTER

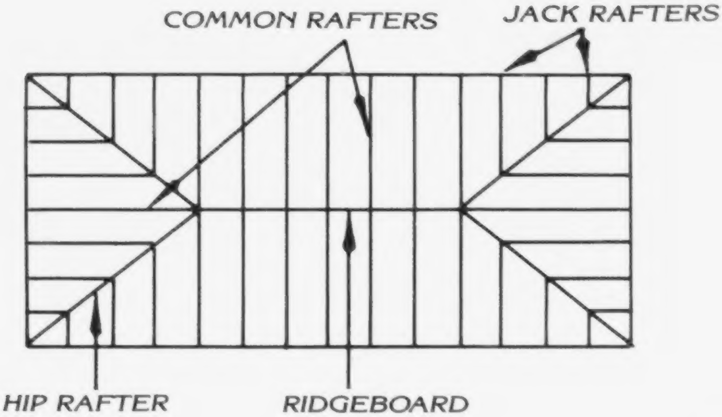
JOB SHEET #2

FIGURE 58



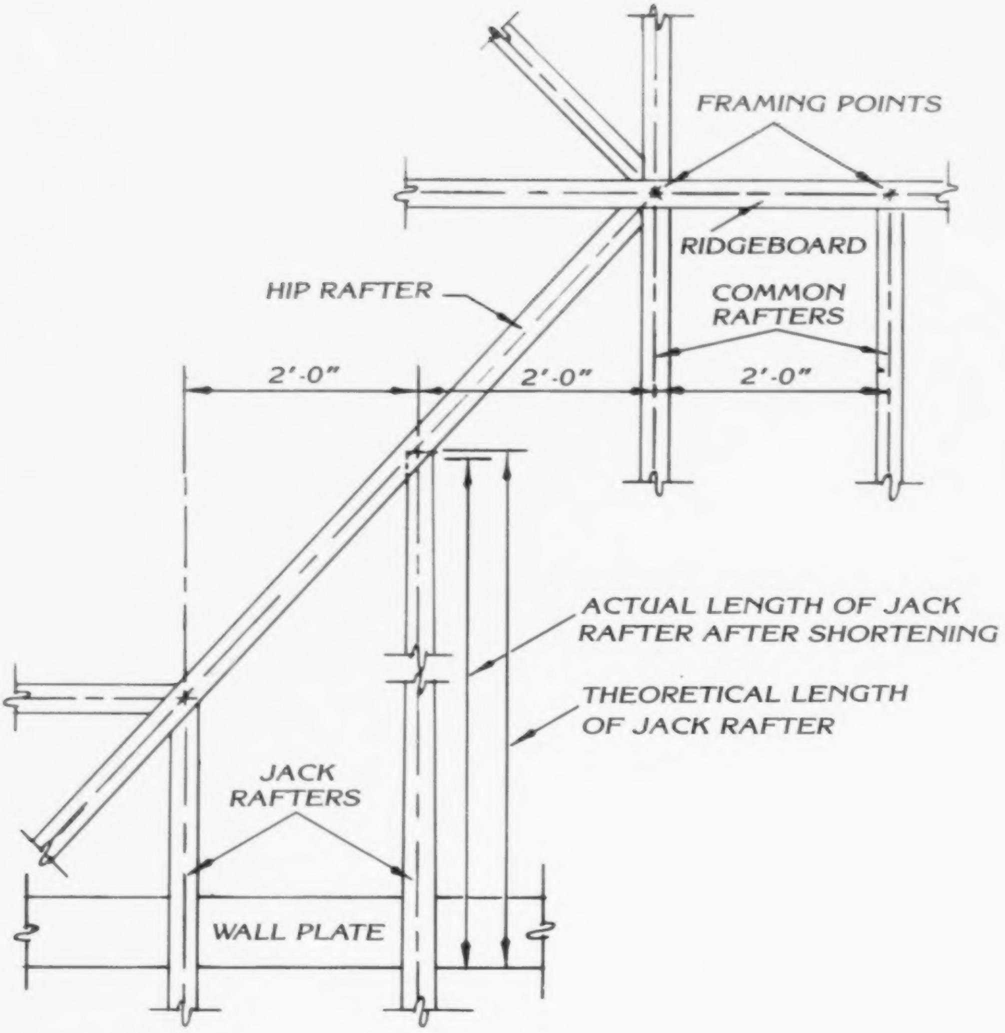
d. Shorten rafter (Figures 59 and 60)

FIGURE 59


COMMON RAFTERS
JACK RAFTERS
HIP RAFTER
RIDGEBOARD

JOB SHEET #2

FIGURE 60

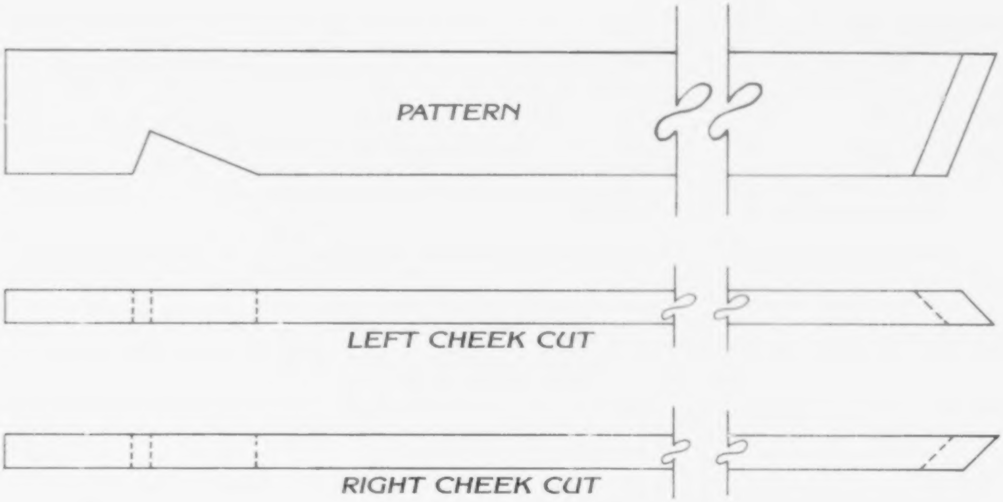

FRAMING POINTS
RIDGEBOARD
HIP RAFTER
COMMON RAFTERS
2'-0"
2'-0"
2'-0"
ACTUAL LENGTH OF JACK RAFTER AFTER SHORTENING
THEORETICAL LENGTH OF JACK RAFTER
JACK RAFTERS
WALL PLATE

JOB SHEET #2

e. Lay out and cut all jack rafters (Figure 61)

(NOTE: For every jack rafter with a cheek cut on the left, there must be one of equal length with a cheek cut on the right.)

FIGURE 61



B. Erect rafters

(NOTE: For simplification, ceiling joists are not shown in the following illustrations.)

1. Gable roof

CAUTION

Place boards across ceiling joists to walk on.

a. Lean all rafters against sides of structure at each rafter location mark, with ridgeboard plumb cut up

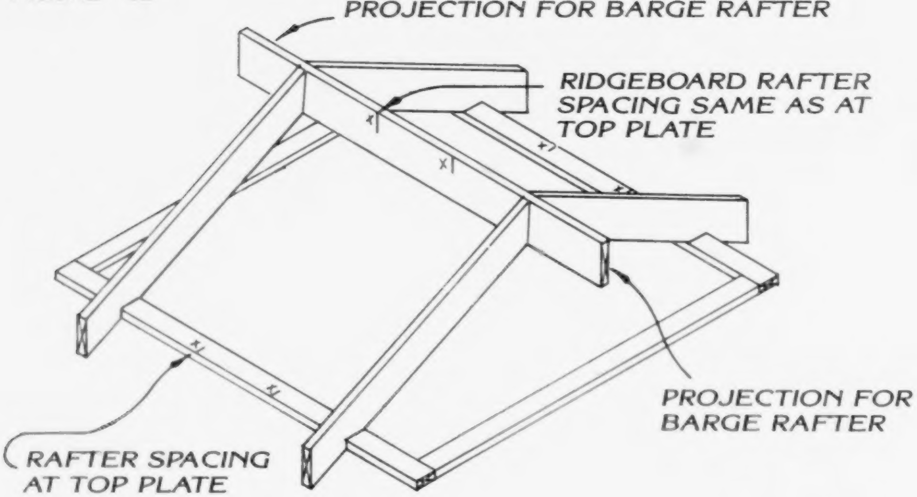
b. Erect and plumb rafter at second rafter location marked on top plate, nailing with 16d box nails through the ridgeboard into rafter (See Figure 62)

c. Nail rafter on opposite side

(NOTE: Be sure that the top of all rafters are flush with the top of the ridgeboard and inside the marks on the ridgeboard.)

JOB SHEET #2

FIGURE 62


PROJECTION FOR BARGE RAFTER
RIDGEBOARD RAFTER SPACING SAME AS AT TOP PLATE
PROJECTION FOR BARGE RAFTER
RAFTER SPACING AT TOP PLATE

d. Toenail seat of bird's-mouth cut to plate, using 16d box nails

(NOTE: Be sure that the plumb cut of the bird's-mouth is snugged up to the outside of the top plate. Use a temporary brace to hold the ridgeboard up until the nailing is accomplished.)

e. Erect remaining common rafters

(NOTE: Keep the ridgeboard straight. To accomplish this, erect opposing pairs and stretch a string along the top of the center of the ridgeboard as a guide.)

f. Erect end rafters; plumb and brace

g. Frame gable end

(NOTE: See Job Sheet #3.)

2. Hip roof

CAUTION

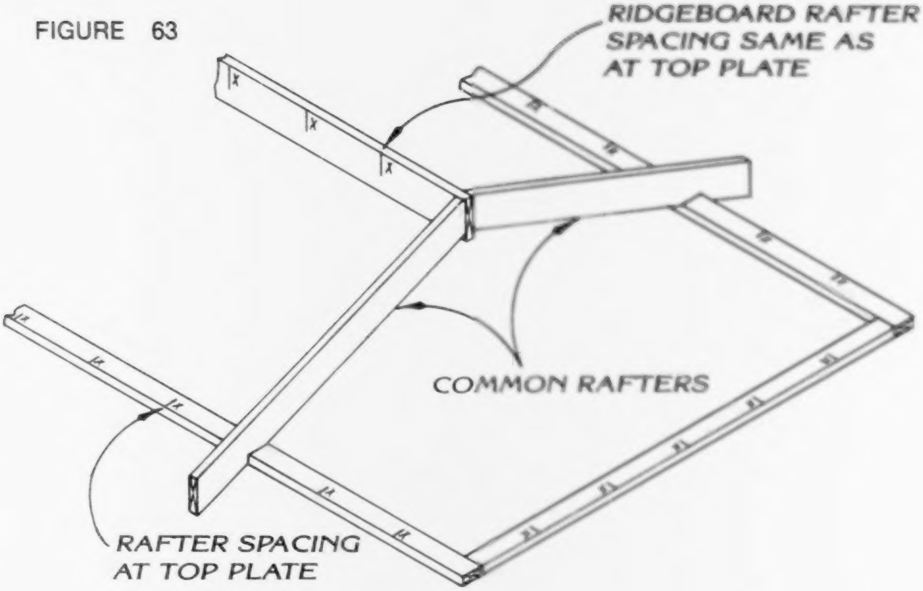
Place boards across ceiling joists to walk on.

a. **Lean all rafters against sides of structure at each rafter location mark, with ridgeboard plumb cut up**

b. Erect end common rafters on sides (See Figure 63)

JOB SHEET #2

FIGURE 63


RIDGEBOARD RAFTER SPACING SAME AS AT TOP PLATE
COMMON RAFTERS
RAFTER SPACING AT TOP PLATE

1) Nail through ridgeboard into end of rafters with 16d box nails

   (NOTE: Be sure that tops of all rafters are flush with top of ridgeboard.)

2) Toenail seat of bird's-mouth cut to top plate with 16d box nails

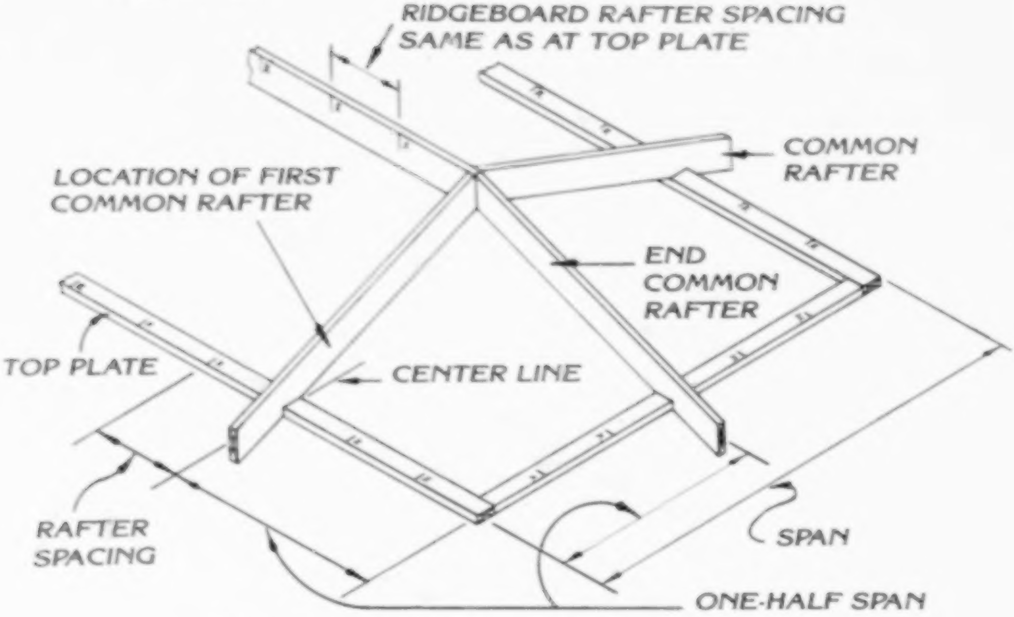
   (NOTE: Be sure that the plumb cut of the bird's-mouth is snugged up to the outside of the top plate.)

c. Erect end common rafters, toenailing into ridgeboard and into top plate (See Figure 64)

   (NOTE: Be sure that the top of the rafters are flush with the top of the ridgeboard and that the plumb cut of the bird's-mouth is snug to the outside of the top plate.)

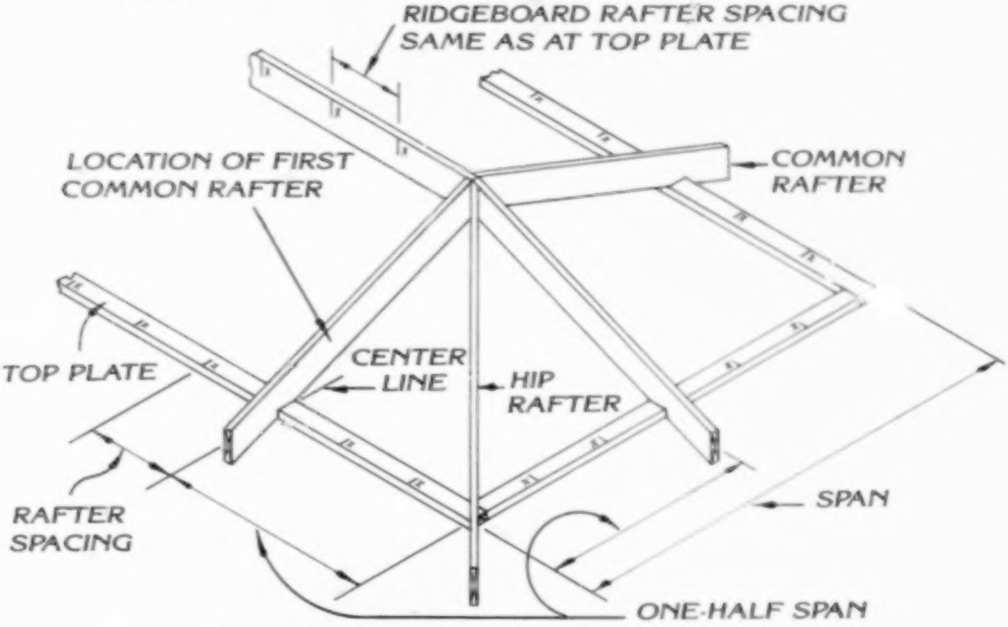
JOB SHEET #2

FIGURE 64


RIDGEBOARD RAFTER SPACING SAME AS AT TOP PLATE
COMMON RAFTER
LOCATION OF FIRST COMMON RAFTER
END COMMON RAFTER
TOP PLATE
CENTER LINE
RAFTER SPACING
SPAN
ONE-HALF SPAN

d. Erect hip rafters (Figure 65)

FIGURE 65


RIDGEBOARD RAFTER SPACING SAME AS AT TOP PLATE
LOCATION OF FIRST COMMON RAFTER
COMMON RAFTER
TOP PLATE
CENTER LINE
HIP RAFTER
RAFTER SPACING
SPAN
ONE-HALF SPAN

e. Erect hip jack rafters

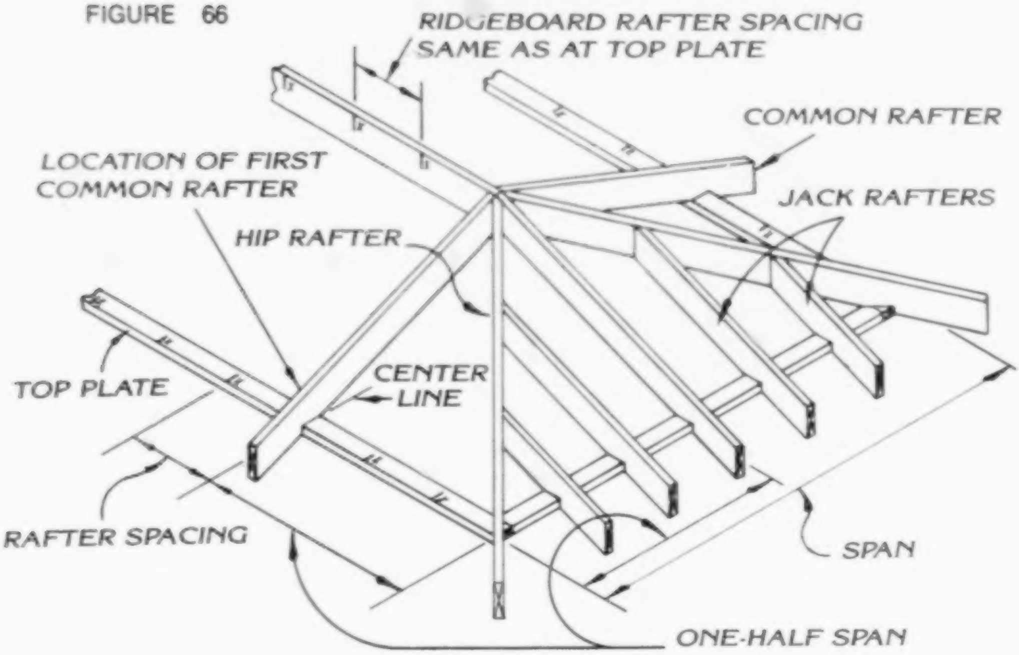
JOB SHEET #2

1) Proceed from longest to shortest rafter

2) Do both sides of hip at same time (Figure 66)

(NOTE: Nail through the common rafter into the hip rafter at the cheek with 8d box nails. Be sure to keep the top of the hip in a straight line from top to bottom.)

FIGURE 66


RIDGEBOARD RAFTER SPACING SAME AS AT TOP PLATE
COMMON RAFTER
LOCATION OF FIRST COMMON RAFTER
JACK RAFTERS
HIP RAFTER
CENTER LINE
TOP PLATE
RAFTER SPACING
SPAN
ONE-HALF SPAN

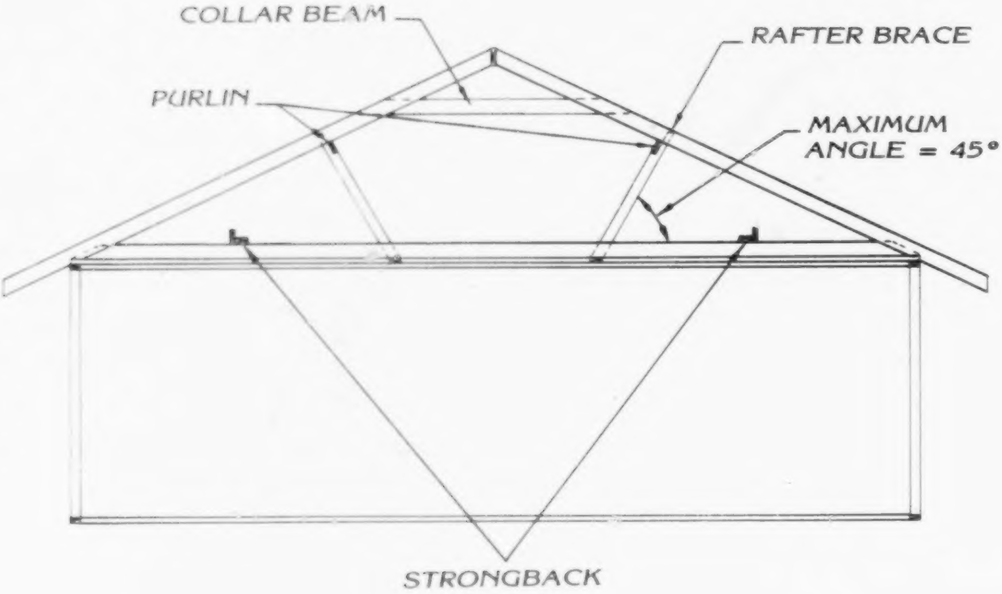
3) Stretch a string from the top of the hip to the bottom to aid in keeping the hip line straight

f. Erect remaining rafters

C. Install purlins, strongbacks, and collar beams as required (See Figure 67)

JOB SHEET #2

FIGURE 67


COLLAR BEAM
RAFTER BRACE
PURLIN
MAXIMUM ANGLE = 45°
STRONGBACK

D. Trim rafter tails

1. Mark length of each end rafter at determined length
2. Chalk a line on top of all rafters to locate cutting line

   (NOTE: It may be necesary to adjust procedures for crooked rafter tails.)

JOB SHEET #2

3. Mark side of each rafter with framing square for a square end cut

4. Cut off tails with power handsaw

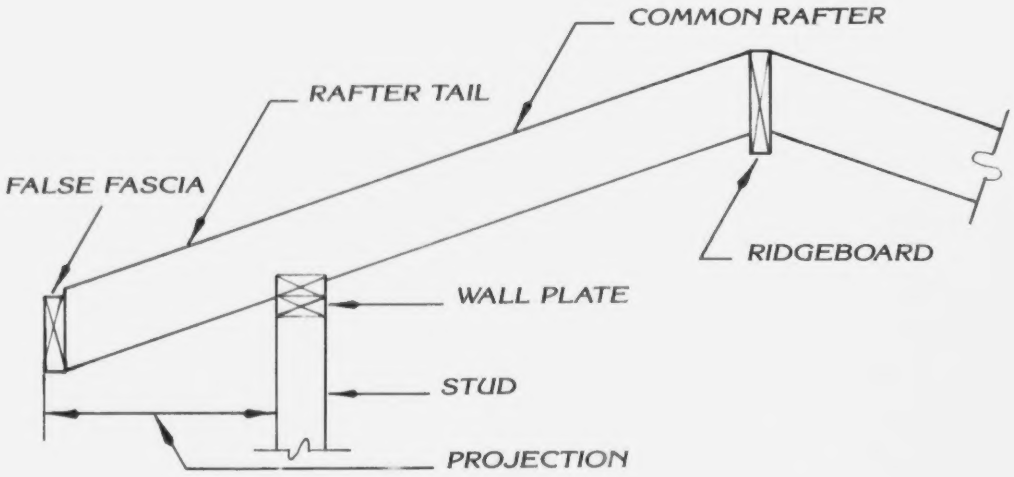
CAUTION

Erect a platform to use while cutting, and assume a comfortable and safe position before starting each cut.

E. Nail false fascia to ends of all rafters around structure's perimeter, allowing ends on gable roof to extend far enough for barge rafter (Figure 68)

(NOTE: When projection exceeds 16 inches, lookouts are needed and are placed every 2 feet. All splices for false fascia must be on rafter ends.)

FIGURE 68

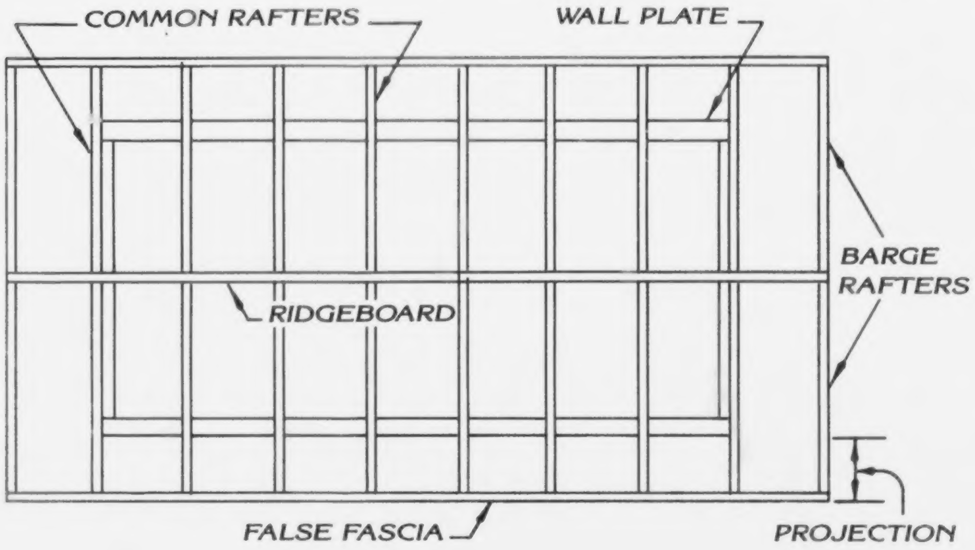

COMMON RAFTER
RAFTER TAIL
FALSE FASCIA
RIDGEBOARD
WALL PLATE
STUD
PROJECTION

F. Install barge rafters on gable roof (See Figure 69)

(NOTE: Additional lookouts may be needed to support the barge rafters. Barge rafters have no bird's-mouth cut.)

JOB SHEET #2

FIGURE 69


COMMON RAFTERS
WALL PLATE
BARGE RAFTERS
RIDGEBOARD
FALSE FASCIA
PROJECTION

G. Clean up area and put away all tools and materials

ROOF FRAMING
UNIT III

JOB SHEET #3 — FRAME A GABLE END WITH VENT OPENING

I. Tools and materials

- A. 100-foot tape
- B. Folding rule or steel tape
- C. Framing square
- D. Claw hammer
- E. Handsaw
- F. Power handsaw and extension cord
- G. Hand level
- H. Plumb bob and line
- I. Stud material
- J. 16d and 8d nails
- K. Specifications (furnished by instructor)

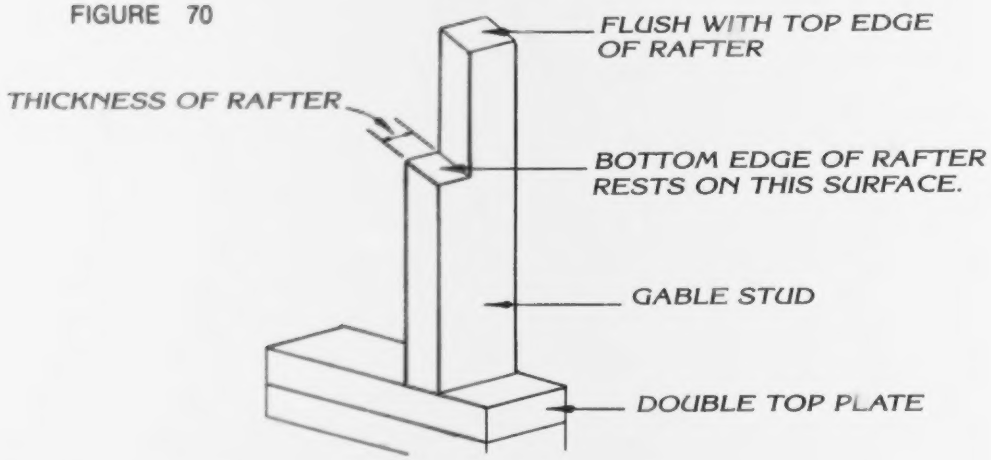
II. Procedure

- A. Plumb down from center of gable to top of end-wall top plate
- B. Square a line across end-wall top plate at determined point
- C. Lay out vent opening by measuring from center line each way one-half the opening size needed for vent
- D. Lay out and mark stud locations as specified
- E. Stand a stud upright at first mark and plumb it
- F. Mark across edge of stud at underside of rafter (See Figure 70)

  (NOTE: This mark will give the correct cutting angle; cut only the depth of the thickness of the rafter.)

JOB SHEET #3

FIGURE 70

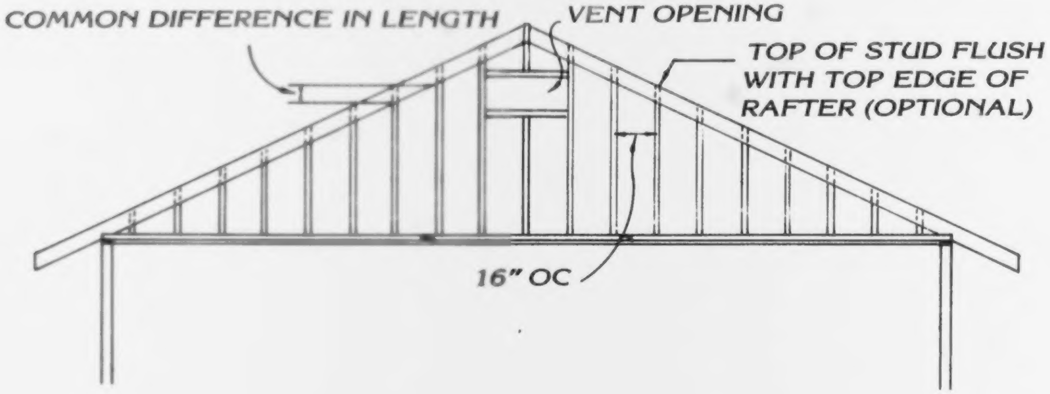

FLUSH WITH TOP EDGE OF RAFTER
THICKNESS OF RAFTER
BOTTOM EDGE OF RAFTER RESTS ON THIS SURFACE.
GABLE STUD
DOUBLE TOP PLATE

G. Repeat steps E and F at remaining stud locations

H. Cut all studs, plumb them in place, and nail in position

(NOTE: When stud spacing is laid out from a center line as above, cut studs in pairs, as they will fit on each side. Distance in length between the two studs will be the common difference and can be used to cut all the other studs. See Figure 71.)

FIGURE 71


COMMON DIFFERENCE IN LENGTH
VENT OPENING
TOP OF STUD FLUSH WITH TOP EDGE OF RAFTER (OPTIONAL)
16" OC

I. Nail in header and sill for vent

J. Nail cripple studs in center above and below vent opening

K. Clean up area and put away all tools and materials

ROOF FRAMING
UNIT III

JOB SHEET #4 — CONSTRUCT OPENING FOR A CHIMNEY

I. Tools and materials

- A. 100-foot tape
- B. Folding rule or steel tape
- C. Framing square
- D. Claw hammer
- E. Power handsaw and extension cord
- F. Hand level
- G. Plumb bob and line
- H. Pencil
- I. Joist and header material
- J. 16d and 8d nails
- K. Plans (furnished by instructor)

II. Procedure

- A. Check plans to establish chimney location
- B. Lay out opening on floor

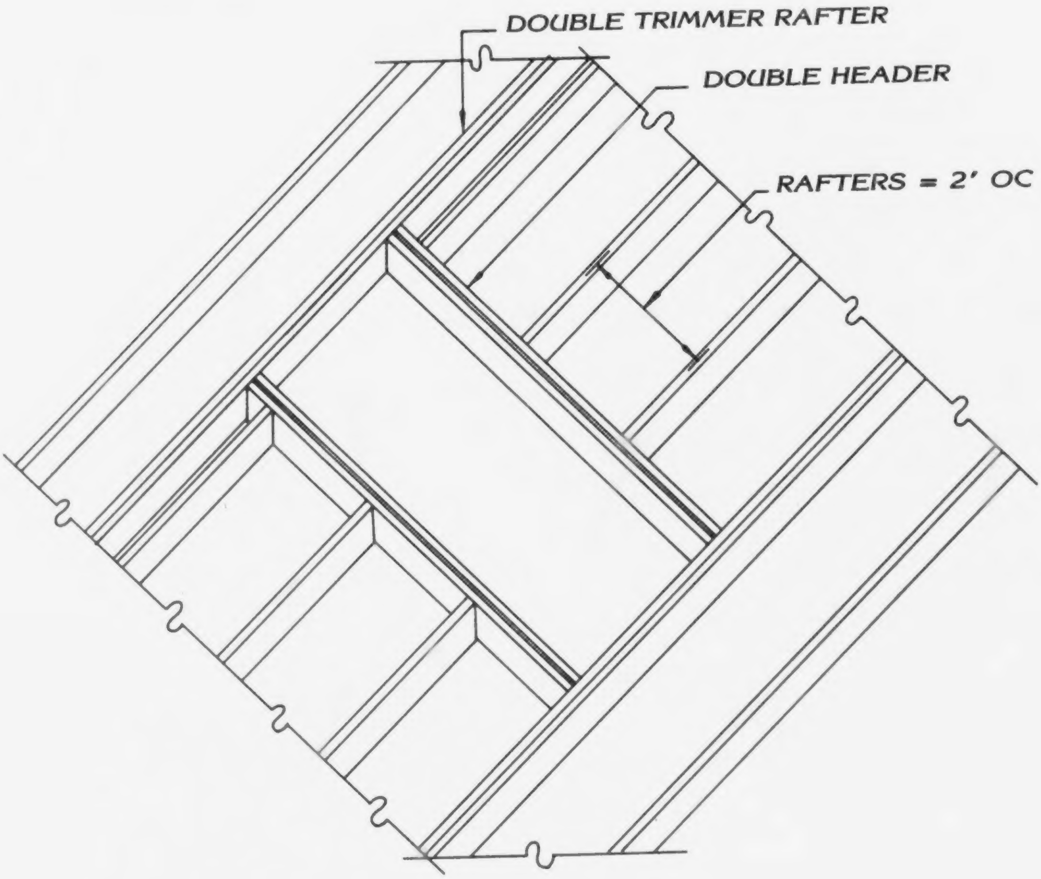
  (NOTE: Provide at least 2-inch clearance on ends and sides.)
- C. Use plumb bob and line to lay out opening on rafters from floor layout
- D. Nail temporary board across top of rafters to be cut

  (NOTE: Board will hold ends of rafters in place until headers are installed.)
- E. Measure and cut headers to size
- F. Cut rafter, allowing for clearance and double headers if required (See Figure 72)

  (NOTE: Double headers should be used on large openings.)
- G. Plumb and nail headers in place
- H. Add trimmer rafter to both sides of opening (See Figure 72)

JOB SHEET #4

FIGURE 72


DOUBLE TRIMMER RAFTER
DOUBLE HEADER
RAFTERS = 2' OC

I. Clean area and put away tools and materials

ROOF FRAMING
UNIT III

JOB SHEET #5 — APPLY ROOF SHEATHING

I. Tools and materials

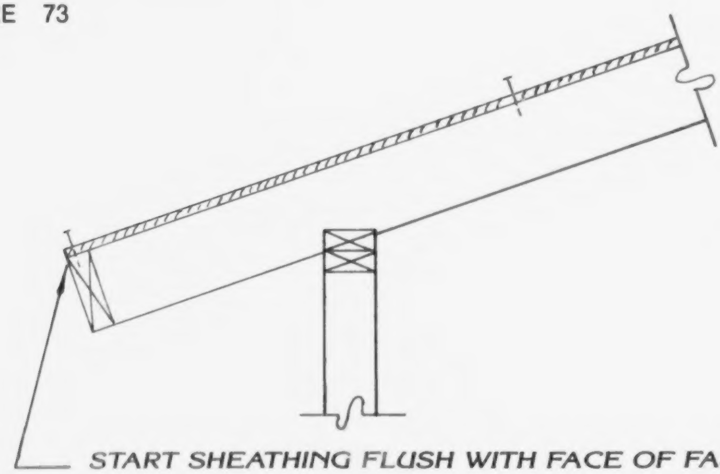
- A. Power handsaw and extension cord
- B. Claw hammer
- C. Folding rule or steel tape
- D. Chalk line
- E. Nails as specified for sheathing
- F. Plans and specifications (furnished by instructor)

(NOTE: See specifications for sheathing material used to determine special installation requirements.)

II. Procedure

A. Start first sheathing board flush with face of false fascia and flush with face of barge rafter (Figure 73)

FIGURE 73



START SHEATHING FLUSH WITH FACE OF FASCIA.

B. Allow sheathing to run wild over hip on hip roof; chalk a line and cut with power handsaw after sheathing has been installed

JOB SHEET #5

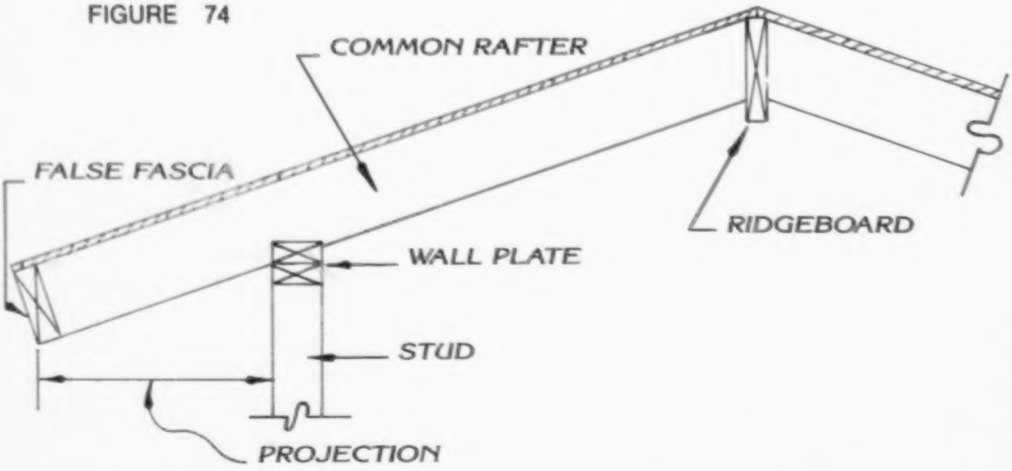
C. Tack all boards in place; chalk a line on center of each rafter and finish nailing (NOTE: All splices must be made on a rafter with joints staggered.)

D. Finish ridge

   1. Cut first side to fit center of ridgeboard

   2. Cut opposite side to fit center of ridgeboard (Figure 74)

FIGURE 74


COMMON RAFTER
FALSE FASCIA
RIDGEBOARD
WALL PLATE
STUD
PROJECTION

E. Clean area and put away tools and materials

ROOF FRAMING
UNIT III

JOB SHEET #6 — ERECT TRUSSES ON A GABLE ROOF

I. Tools and materials

   A. Claw hammer

   B. String line

   C. Folding rule or steel tape

   D. 100-foot tape

   E. Hand level

   F. Framing square

   G. Trusses

   H. 2×4s for braces

   I. 2×4s for stakes

   J. 16d and 8d nails

   K. 1×6s or plywood for catwalk

   L. Plans

   M. Pencil

II. Procedure

   A. Check plans to determine whether exterior finish is to be masonry or siding

   B. Lay out end truss to allow for exterior finish

   C. Use framing square to mark truss locations 2 feet on center on top plates

   D. Measure and mark trusses 1 inch in

   E. Place trusses on ground along one outside wall with one end of trusses sitting on wall

   F. Raise opposite end of one truss and set on opposite outside wall

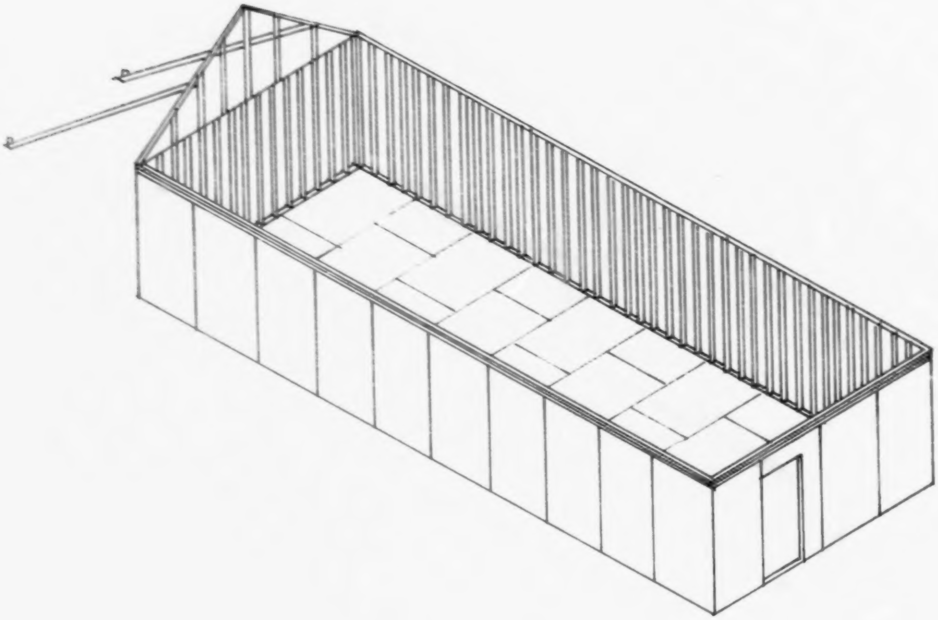
   G. Raise remaining trusses to top of walls following procedure in step F

   H. Starting at one end of structure, set first end truss (See Figure 75)

JOB SHEET #6

1. Raise and plumb truss
2. Nail and brace from outside

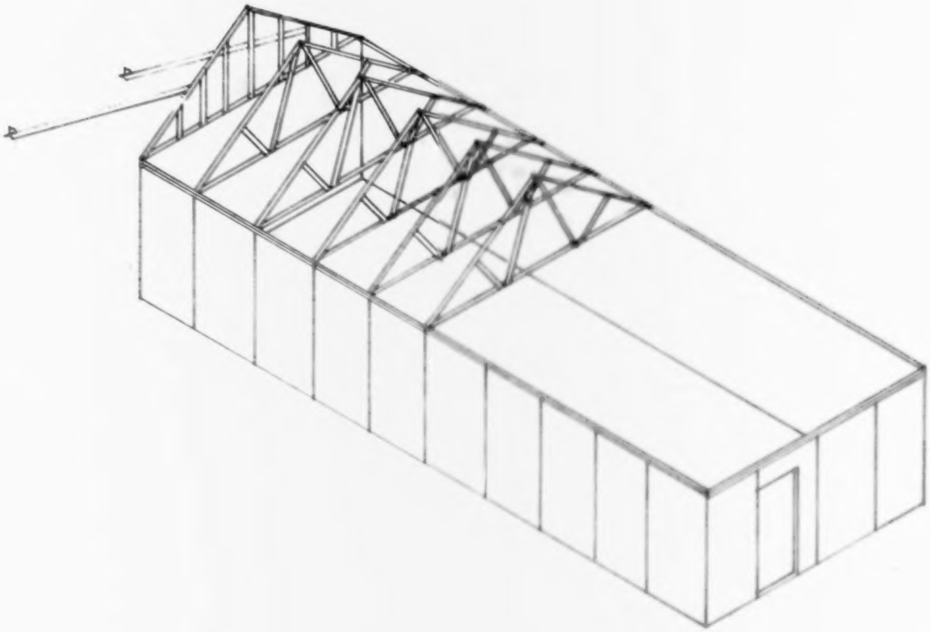
FIGURE 75



I. Continue procedure in step H to set trusses until all are set except last four or five (See Figure 76)

JOB SHEET #6

FIGURE 76



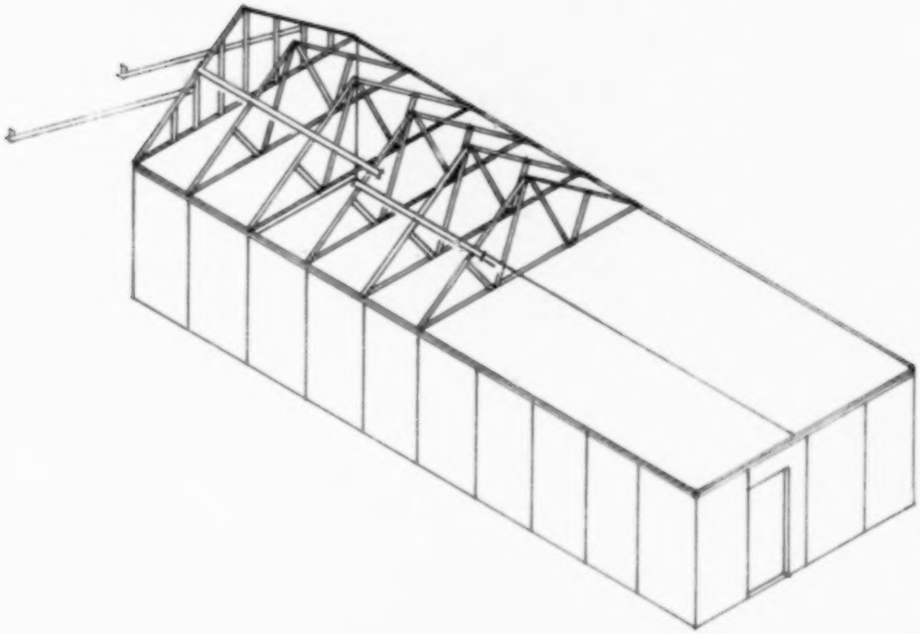
J. Stack remaining four or five trusses away from end of structure and if necessary nail a temporary brace in place to keep trusses from racking (See Figure 77)

(NOTE: For simplification, trusses stacked on framing have been omitted in illustration.)

K. Set, plumb, brace, and nail end truss (See Figure 77)

JOB SHEET #6

FIGURE 77



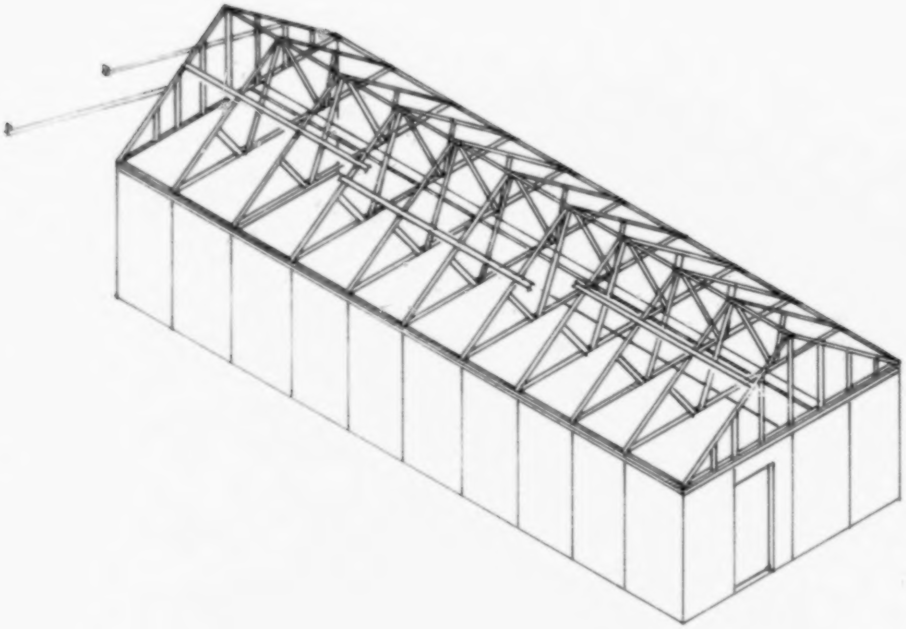
L. Set, plumb, brace, and nail remaining trusses

M. Pull line through top of ridge and check that ridge is straight

N. Recheck trusses at top for 2 feet on center; add braces if necessary (See Figure 78)

JOB SHEET #6

FIGURE 78



O. Lay out and nail horizontal bracing on top of bottom chord to hold truss at proper spacing

P. Install sheathing (See Job Sheet #5)

Q. Remove temporary bracing when you have worked up to the bracing

R. Clean up area and put away tools and materials

ROOF FRAMING
UNIT III

TEST

NAME ______________________________ SCORE ______________

1. Match to their correct definitions terms associated with roof framing. Write the correct numbers in the blanks. Definitions continue on the next page.

_____a. Structure that projects from a sloping roof and usually includes a window

_____b. Angle or degree of slope of roof

_____c. Total height of rafter above top plate

_____d. Rafter that extends diagonally from top plate to form the intersection of an internal roof angle

_____e. Horizontal distance from outside of top plate to center line of ridgeboard; usually one-half of span

_____f. Horizontal distance from outside of one exterior wall to outside of opposite exterior wall

_____g. Exposed rafter that is located at end of gable roof

_____h. Rafter that extends from double top plate to ridgeboard; roof's main framing member

_____i. Rafter that extends from double top plate at corner of structure to ridgeboard, forming the angle for a hip roof

_____j. Short rafter that fits between top plate and hip or valley rafter, or between ridgeboard and hip or valley rafter

_____k. Inclination of roof's surface expressed as one unit of rise or fall to so many horizontal units, usually "X" inches in twelve

_____l. Brace used in framing to strengthen or improve alignment of other framing members

_____m. Horizontal distance from building to edge of roof

1. Valley rafter
2. Span
3. Jack rafter
4. Slope
5. Strongback (stiff-back)
6. Rise
7. Barge rafter (verge rafter)
8. Rake
9. Dormer
10. Projection
11. Overhang
12. Pitch
13. Hip rafter
14. Run
15. Common rafter

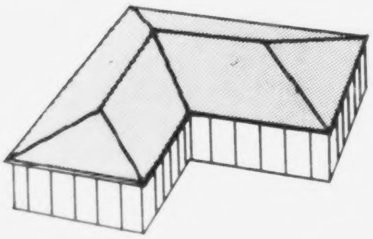
TEST

_____n. Section of roof that extends from building line to edge of roof

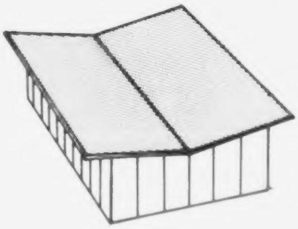
_____o. Trim members that run parallel to roof slope and form finish between roof and wall at gable end

2. Identify the roof styles illustrated below and on the following pages. Write the correct names in the blanks.

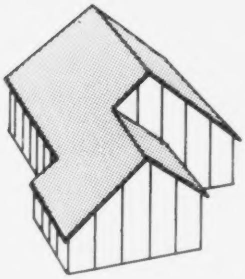
L-shaped hip roof
Butterfly roof
Mansard roof
Flat roof
Gable roof
Hip roof
Shed roof (lean-to roof)
Continuous-slope gable roof
L-shaped gable roof
Gambrel roof
Gable roof with dormer



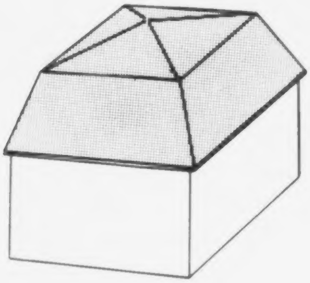
a. ______________________



b. ______________________

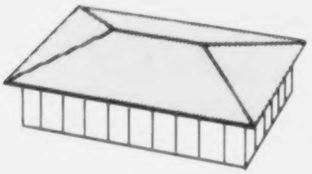


c. ______________________

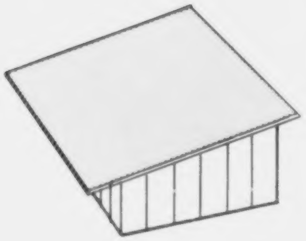


d. ______________________

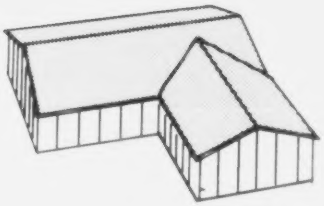
TEST



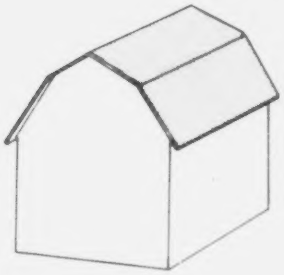
e. ______________________



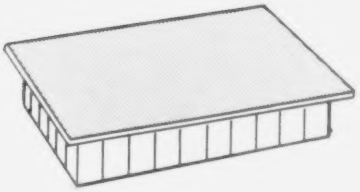
f. ______________________



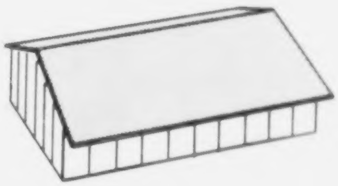
g. ______________________



h. ______________________

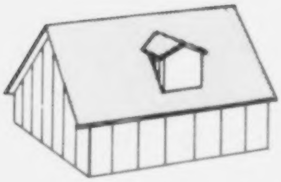


i. ______________________



j. ______________________

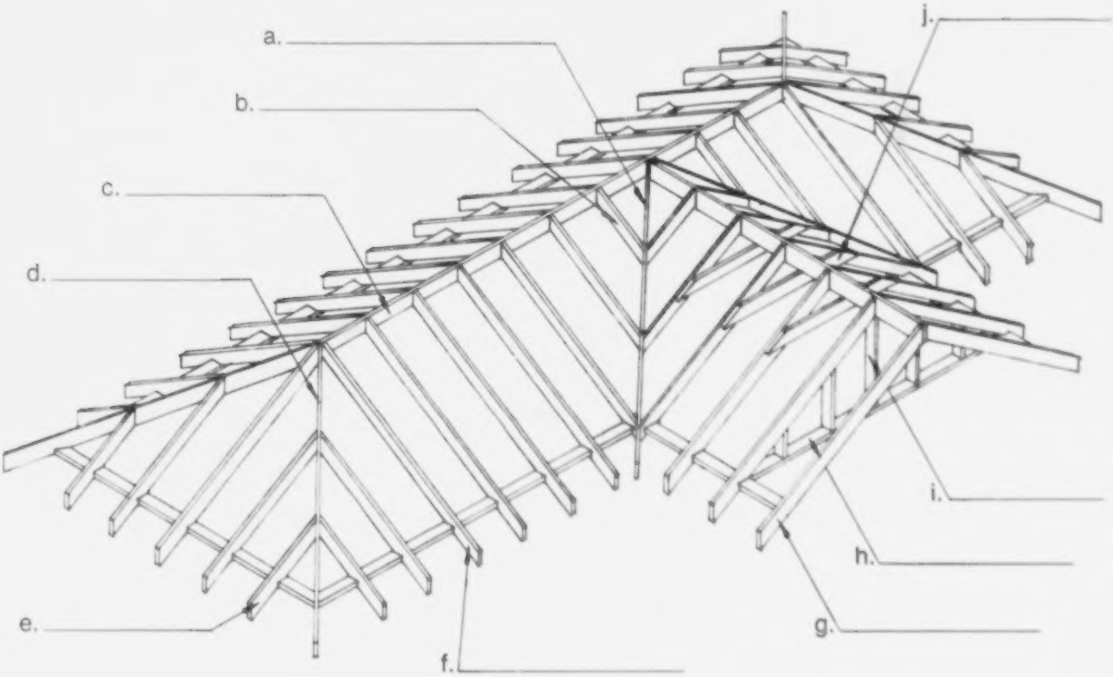
TEST



k. ______________________________

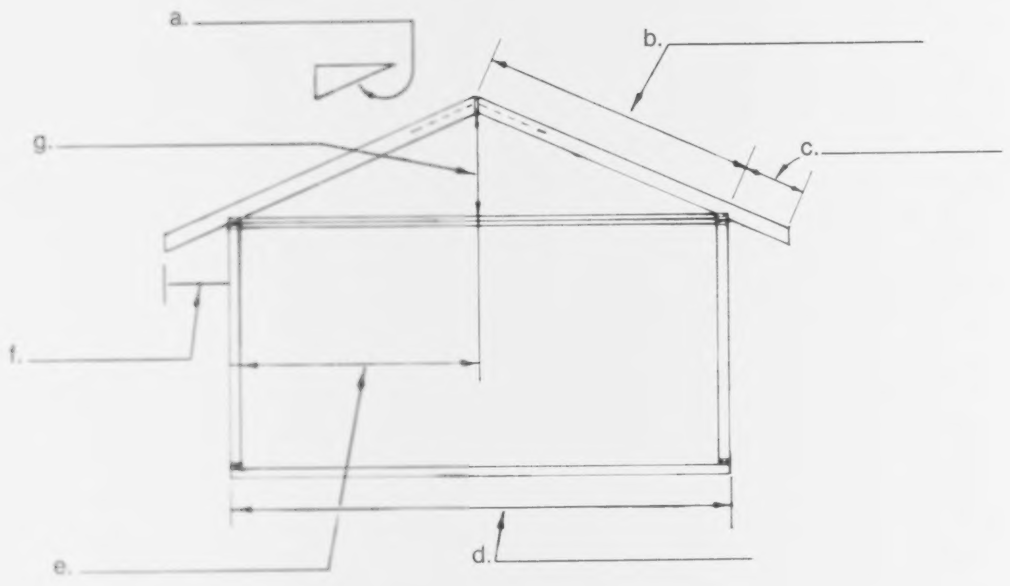
3. Identify the roof framing members in the illustration below. Write the correct names in the blanks.

Rafter tail
Top plate
Valley jack rafter
Hip jack rafter
Valley rafter
Gable stud
Ridgeboard
Hip rafter
Common rafter
Collar beam



TEST

4. Label the roof framing units in the illustration below.



5. Discuss slope and pitch ratios.

    a. Slope — ____________________

    ____

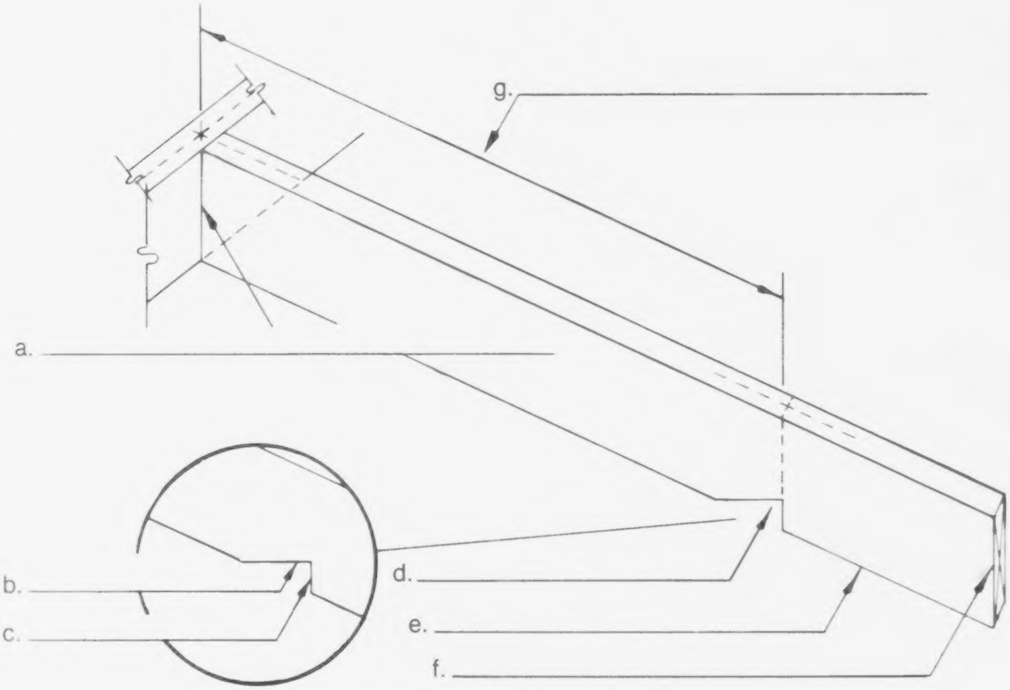
    b. Pitch — ____________________

    ____

TEST

6. Identify the parts of the rafter illustrated below. Write the correct names in the blanks.

Tail (overhang)
Tail cut
Plumb cut at ridgeboard
Seat cut
Line length of rafter
Plumb cut
Bird's-mouth



7. List methods for determining rafter length.

a. ____________________

b. ____________________

TEST

8. Compute the length of a common rafter for a structure with a span of 26′-0″ and a rise of 8 inches per foot. Use the framing-square table pictured below.

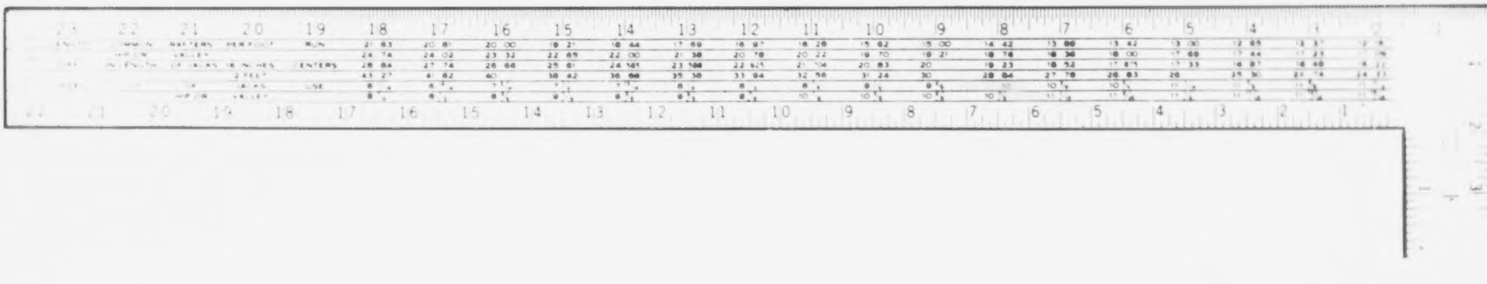
   Rafter length = ______________________________

9. Compute the length of a hip rafter for a building with a run of 14′-0″ and a rise of 6 inches per foot. Use the framing-square table pictured below.

   Rafter length = ______________________________

10. Compute the length of the second jack rafter for a building with a run of 12′-0″, a span of 24′-0″, a rise of 5 inches per foot, and rafters on 2-foot centers. Use the framing-square table pictured below.

    Rafter length = ______________________________



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TEST

11. Match to their correct definitions terms associated with trusses. Write the correct numbers in the blanks.

_____a. Truss member connecting top and bottom chords in tension

_____b. Combination of framing members that is usually constructed in a triangular unit and used as a rigid framework to support loads over long spans

_____c. Upper truss member

_____d. Corrugated and toothed thin steel ring; used to strengthen wood-to-wood connections

_____e. Timber made of thin pieces of lumber that have been glued together

_____f. Lower truss member

_____g. Truss member connecting top and bottom chords in compression

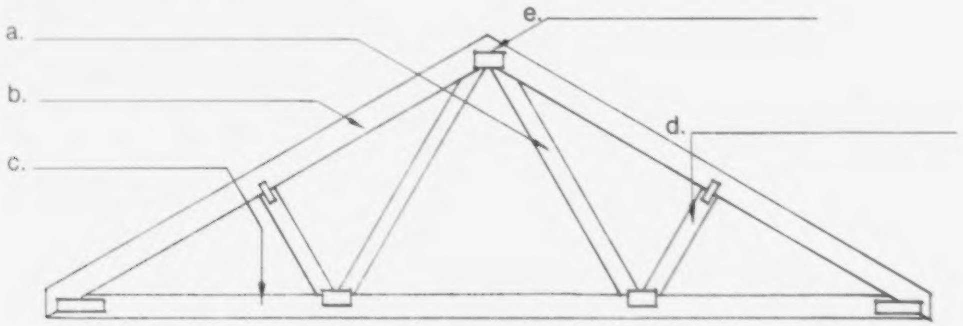
_____h. Steel plate with a number of uniform nails that have been stamped out to protrude at right angles from the plate itself; used to strengthen wood-to-wood connections

_____i. Steel ring with a tongue-and-grooved split in the band; used to strengthen wood-to-wood connections

1. Truss
2. Bottom chord
3. Gang-nail plate
4. Top chord
5. Glue-laminated timber
6. Split ring
7. Tension web
8. Toothed ring
9. Compression web

12. Identify the main parts of the truss illustrated below. Write the correct names in the blanks.

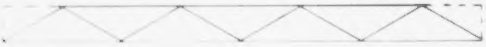
Gang-nail plate **Bottom chord** **Top chord**
Compression web **Tension web**



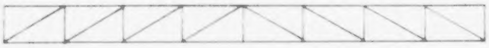
TEST

13. Identify the types of trusses illustrated below. Write the correct names in the blanks.

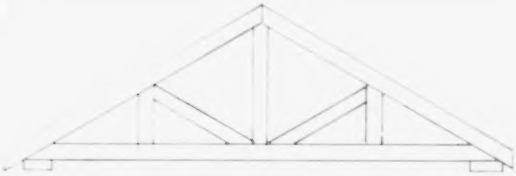
Warren flat truss
Hip-louver truss
Hip truss
Modified queen-post truss
Standard Howe truss
Bowstring truss
Double-W truss
Howe flat truss
Scissors truss



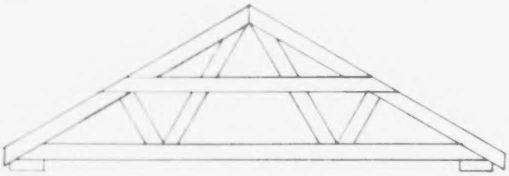
a. ______________________________



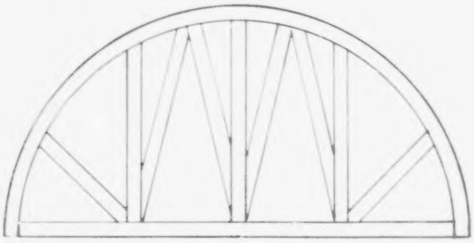
b. ______________________________



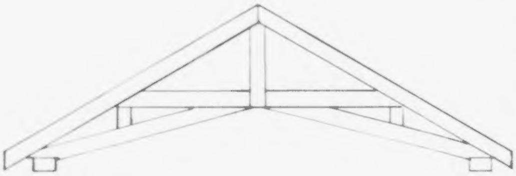
c. ______________________________



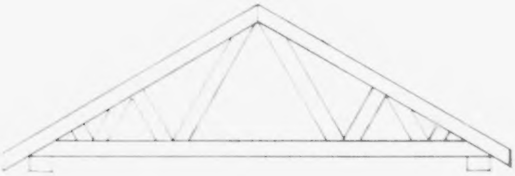
d. ______________________________



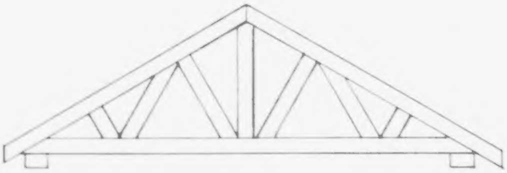
e. ______________________________



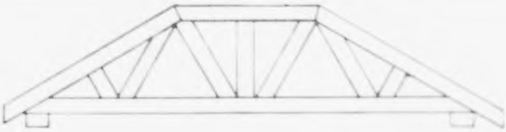
f. ______________________________



g. ______________________________



h. ______________________________

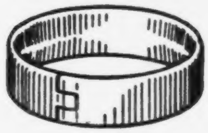


i. ______________________________

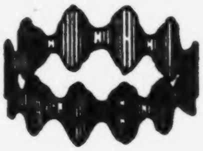
TEST

14. Identify the hardware used in truss construction. Write the correct names in the blanks.

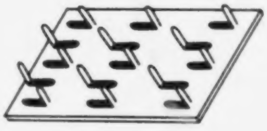
Toothed ring
Gang-nail plate
Shear plate
Split ring
Malleable washer
Machine bolt
Plywood gusset
Plate washer



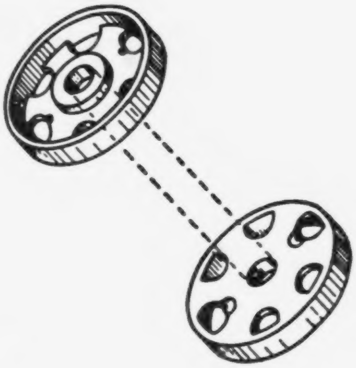
a. ____________________



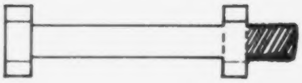
b. ____________________



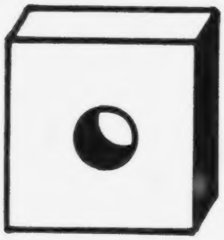
c. ____________________



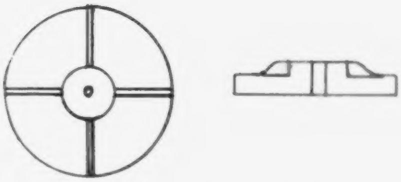
d. ____________________



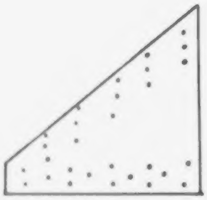
e. ____________________



f. ____________________



g. ______________________________



h. ______________________________

TEST

15. List four types of vents used in roof construction.

    a. ______________________________

    b. ______________________________

    c. ______________________________

    d. ______________________________

16. Estimate the number of common rafters needed to frame a gable roof on a structure that is 24′ × 36′ with 24-inch roof projection over the eaves and gable ends. Space rafters 24 inches on center. Write the correct answer in the blank and show your work.

    Number of common rafters = ______________________________

(NOTE: Test question 17 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

17. Demonstrate the ability to

    a. Lay out rafter locations on top plate and ridgeboard on 2-foot centers.

    b. Lay out, cut, and erect rafters.

    c. Frame a gable end with vent opening.

    d. Construct opening for a chimney.

    e. Apply roof sheathing.

    f. Erect trusses for a gable roof.

ROOF FRAMING
UNIT III

ANSWERS TO TEST

1. a. 9
   b. 12
   c. 6
   d. 1
   e. 14
   f. 2
   g. 7
   h. 15
   i. 13
   j. 3
   k. 4
   l. 5
   m. 10
   n. 11
   o. 8

2. a. L-shaped hip roof
   b. Butterfly roof
   c. Continuous-slope gable roof
   d. Mansard roof
   e. Hip roof
   f. Shed roof (lean-to roof)
   g. L-shaped gable roof
   h. Gambrel roof
   i. Flat roof
   j. Gable roof
   k. Gable roof with dormer

3. a. Valley rafter
   b. Valley jack rafter
   c. Ridgeboard
   d. Hip rafter
   e. Hip jack rafter
   f. Common rafter
   g. Rafter tail
   h. Top plate
   i. Gable stud
   j. Collar beam

4. a. Slope
   b. Line length
   c. Overhang
   d. Span
   e. Run
   f. Projection
   g. Rise

5. Discussion should include the following

   a. Slope — Indicates incline of roof as a ratio of vertical rise to horizontal run
   b. Pitch — Indicates incline of roof as a ratio of vertical rise to span

6. a. Plumb cut at ridgeboard
   b. Seat cut
   c. Plumb cut
   d. Bird's-mouth
   e. Tail (overhang)
   f. Tail cut
   g. Line length of rafter

7. a. Framing-square step-off method
   b. Rafter tables

ANSWERS TO TEST

8. 15'-7 1/2"

9. 15'-7 7/8"

10. 13'-0"

11. a. 7
    b. 1
    c. 4
    d. 8
    e. 5
    f. 2
    g. 9
    h. 3
    i. 6

12. a. Tension web
    b. Top chord
    c. Bottom chord
    d. Compression web
    e. Gang-nail plate

13. a. Warren flat truss
    b. Howe flat truss
    c. Standard Howe truss
    d. Hip-louver truss
    e. Bowstring truss
    f. Scissors truss
    g. Double-W truss
    h. Modified queen-post truss
    i. Hip truss

14. a. Split ring
    b. Toothed ring
    c. Gang-nail plate
    d. Shear plate
    e. Machine bolt
    f. Plate washer
    g. Malleable washer
    h. Plywood gusset

15. Answer should include any four of the following

    a. Three-inch miniature round vent
    b. Four-inch miniature round vent
    c. Ridge vent
    d. Roof vent
    e. Square attic vent
    f. Triangular attic vent
    g. Soffit vent

16. 42

17. Performance skills evaluated to the satisfaction of the instructor

SPECIAL FRAMING
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to identify types of special house designs and special framing projects. The student should also be able to construct a housed staircase. The student will show this knowledge by completing the assignment sheet, job sheet, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with special framing.
2. Identify the types of special house designs.
3. Identify special framing projects.
4. Match to their correct definitions terms associated with stairs.
5. Identify the parts of a staircase.
6. Identify the basic types of stairs.
7. List factors that you must consider when building a staircase.
8. State rules of thumb for unit rise and unit run.
9. Calculate number and size of risers and treads for a stair of given dimensions.
10. Estimate material for housed stairs.
11. Label methods used to secure stringers.
12. Demonstrate the ability to construct a housed stair.

SPECIAL FRAMING
UNIT IV

SUGGESTED ACTIVITIES

I. Instructional materials

A. Objective sheet

B. Suggested activities

C. Transparency masters

1. TM #1 — Types of Stairs

2. TM #2 — Types of Stairs (Continued)

3. TM #3 — Rise and Run of Stairs

4. TM #4 — Unit Rise and Unit Run

D. Information sheet

E. Student Supplement #1 — Stair Data Chart

F. Assignment Sheet #1 — Estimate Material for a Housed Stair

G. Answers to assignment sheet

H. Job Sheet #1 — Construct a Housed Stair

I. Test

J. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Order materials to supplement unit.

1. Book — *Stair Building*. Available from A. Riechers Co., Box 405, Palo Alto, California 94302.

2. Instruction manual for installing zero-clearance fireplace. Available from a fireplace manufacturer.

SUGGESTED ACTIVITIES

3. Transparencies and competency profiles

   (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

4. Building codes concerning house design
5. Literature on types of special house designs
6. Blueprints of special house designs
7. Literature from window, fireplace, lumber, and other material suppliers
8. Blueprints of special framing projects
9. Pictures of staircase types
10. Building codes concerning staircases
11. Samples of hardware used to secure stringers
12. Models of methods used to secure stringers

C. Introduce unit.

SUGGESTIONS:

- Display pictures of a variety of special framing projects; ask students to name others or to give locations of local examples of those displayed.
- Review material in previous units about special foundations and concrete stairs.

D. Provide students with objective sheet; discuss unit and specific objectives.

E. Provide students with information, assignment, and job sheets.

F. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Section I to discuss terms associated with special framing, showing illustrations or actual examples whenever possible.
2. Use Information Sheet, Section II to discuss types of special house designs.

SUGGESTED ACTIVITIES

SUGGESTIONS:

- Emphasize the special aspects and framing requirements of each type of house design discussed in this section of the information sheet; include information on local code restrictions where applicable.

  (NOTE: You may want to use the poster of the parts of a house from Section A, Unit I, "Introduction to Residential Construction" for comparison.)

- Obtain literature on the types of special house designs that are found in your area, or have the students obtain the material and report their findings to the class.

- Invite architects, builders, or others familiar with special designs to talk to the class about the benefits and problems of each design, emphasizing the design's effects on construction techniques and material requirements.

- Show the class blueprints of these special house designs.

3. Use Information Sheet, Section III to discuss special framing projects.

   SUGGESTIONS:

   - Motivate the students by pointing out that such projects are often a part of home remodelling; thus, the student may find immediate use for this information either as a project for a friend, family, self, or as a job if operating independently.

   - Show the class literature from window, fireplace, lumber, and other material suppliers and manufacturers; emphasize special materials used for special framing and their availability.

     EXAMPLES: Redwood or treated lumber for decks, special entry trim

   - Tour neighborhoods and individual homes where special framing designs and special framing can be seen.

   - Provide class with blueprints showing special framing projects.

4. Use Information Sheet, Sections IV and V to discuss terms associated with stairs and the parts of a staircase.

5. Use Information Sheet, Section VI to discuss basic types of stairs.

   SUGGESTIONS:

   - Show the class Transparencies #1 and #2 or pictures of each stair type. Discuss uses of each type of stair and problems that may be encountered in construction.

SUGGESTED ACTIVITIES

- Tour various buildings where types of stairs are located.
- Use *Stair Building* or other resources to relate this and other objectives to the building of stairs.

6. Use Information Sheet, Section VII to discuss factors that you must consider when building a staircase.

   SUGGESTIONS:

   - Discuss local codes and their impact on each factor. Use Transparency #3 as you discuss these factors.
   - When the students compute rise and run or when they are working with staircase designs, relate the factors to actual situations.

7. Use Information Sheet, Sections VIII and IX to discuss rules of thumb for unit rise and run and steps in calculating number and size of risers and treads.

   SUGGESTIONS:

   - Point out that the procedures are the same as for concrete steps.

     (NOTE: If you have covered the information on concrete steps in Section C, Unit II, "Edge Forms," review these two sections only as much as necessary to refresh the students' memories.)

   - Give students lengths for rise and run and ask whether those combinations satisfy the rules for unit rise and run.

     EXAMPLES: 1. Rise 8"; run 11"
     2. Rise 6"; run 9"
     3. Rise 8"; run 8"

     (NOTE: You may want to do this exercise orally, on the chalkboard, or as a handout.)

   - Use Transparency #4 to discuss rise and run; use Transparency #3 to demonstrate calculating rise and run; change dimensions and perform other calculations.
   - Discuss the use of Student Supplement #1, Stair Data Chart.

8. Use Information Sheet, Section X to discuss estimating material for housed stairs.

   SUGGESTIONS:

   - Use Transparency #4 to illustrate the procedure; use various types of baluster designs, staircase designs, dimensions, and materials.

SUGGESTED ACTIVITIES

- Have students calculate number of risers and treads in all work regarding material estimates.
- Have students complete Assignment Sheet #1.

9. Use Information Sheet, Section XI to discuss methods used to secure stringers. Use samples of the hardware involved and models of each method.

G. Provide students with Job Sheet #1.

H. Discuss and demonstrate the procedures in Job Sheet #1.

I. Have students complete Job Sheet #1.

J. Give test.

K. Critique test and discuss in class.

L. Reteach if necessary.

M. Complete appropriate sections of competency profiles.

III. Unit references

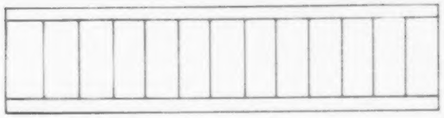
A. Hendrix, Laborn J. "Bud." *Commercial Carpentry.* Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1979.

B. The Majestic Company. *Installation Manual*, Bulletin No. WM 11/980. Huntington, Indiana: American Standard Inc., 1980.

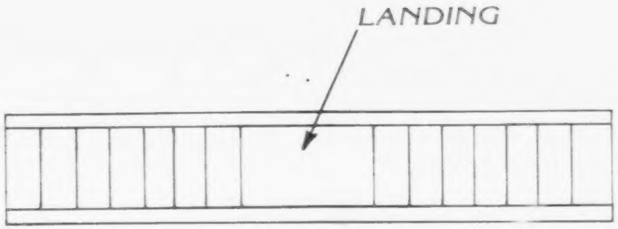
C. Ramsey, Charles G., and Harold R. Sleeper. *Architectural Graphic Standards*, 7th ed. Edited by Robert T. Packard. New York: John Wiley and Sons, Inc., 1981.

D. Riechers, A. *Simplified Stair Building.* Palo Alto, California: John R. Rowe, 1947.

Types of Stairs

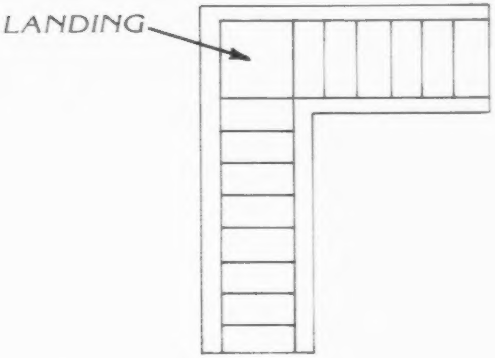


STRAIGHT FLIGHT

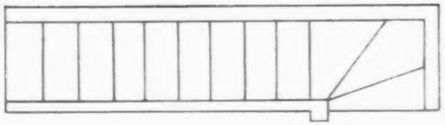


STRAIGHT FLIGHT
WITH LANDING

THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA

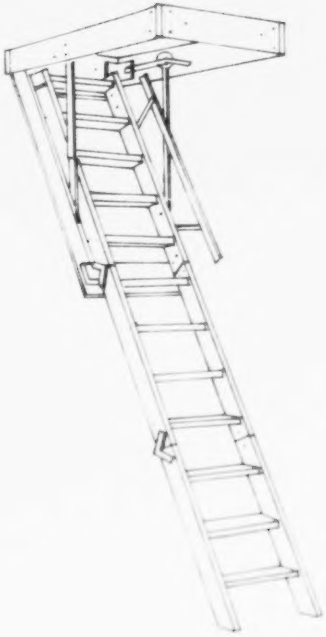


NINETY-DEGREE FLIGHTS
WITH LANDING

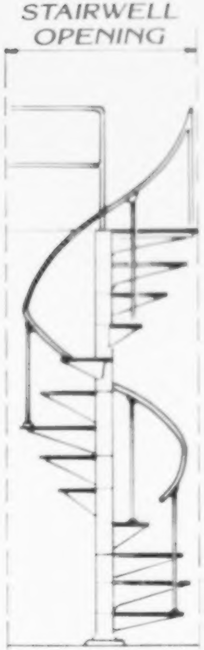


NINETY-DEGREE FLIGHT
WITH WINDERS

Types of Stairs
(Continued)

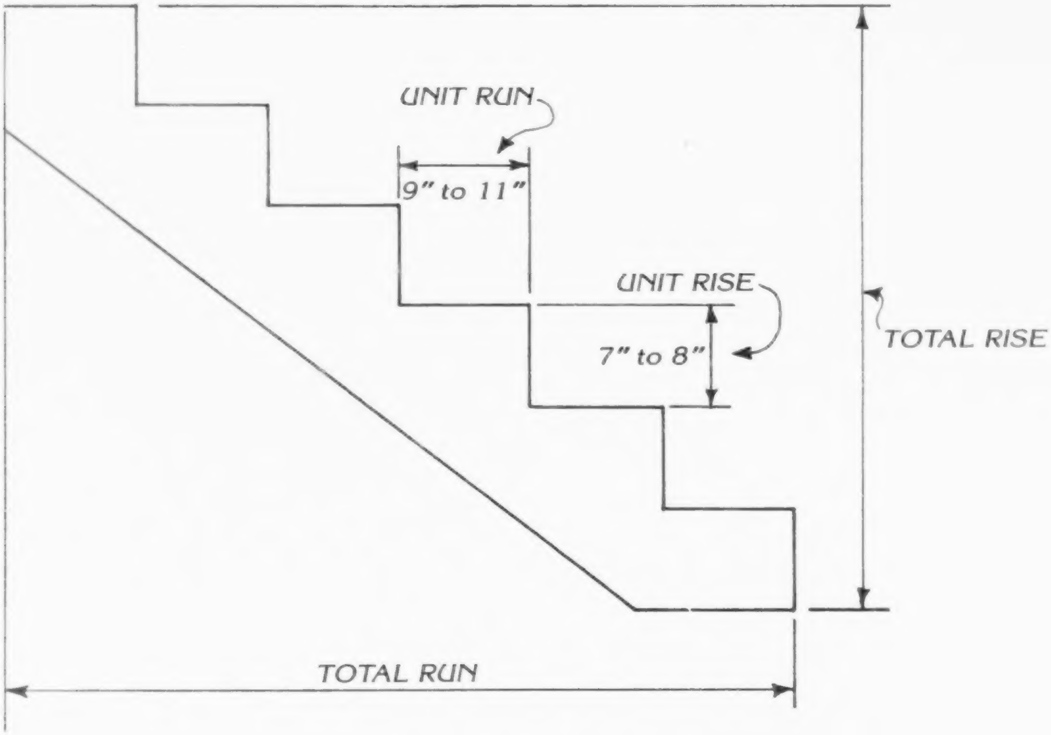


DISAPPEARING UNIT

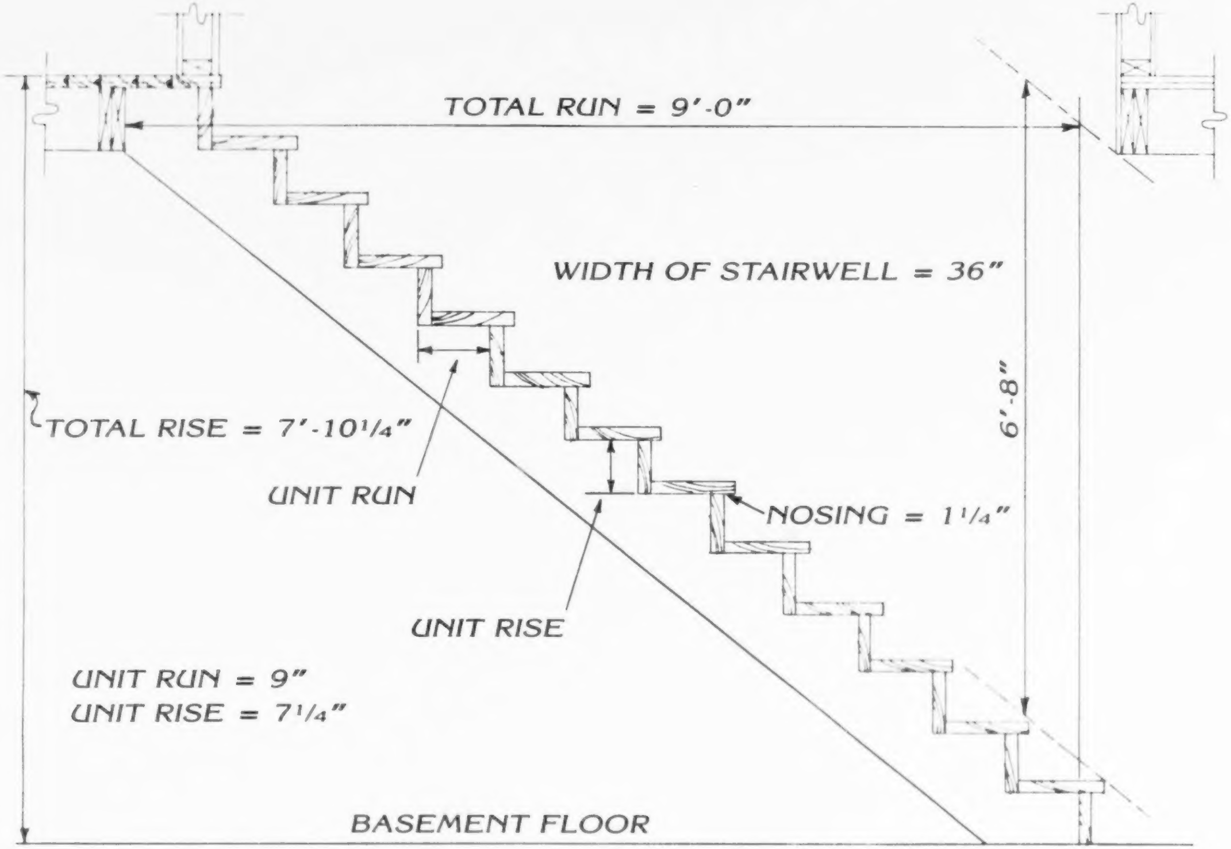

STAIRWELL OPENING

CIRCULAR

Rise and Run of Stairs


UNIT RUN
9" to 11"
UNIT RISE
7" to 8"
TOTAL RISE
TOTAL RUN

Unit Rise and Unit Run


TOTAL RUN = 9'-0"
WIDTH OF STAIRWELL = 36"
6'-8"
TOTAL RISE = 7'-10¼"
UNIT RUN
NOSING = 1¼"
UNIT RISE
UNIT RUN = 9"
UNIT RISE = 7¼"
BASEMENT FLOOR

SPECIAL FRAMING
UNIT IV

INFORMATION SHEET

I. Terms and definitions associated with special framing

   A. Bay window — Window or group of windows usually supported on a foundation extending beyond main wall of structure

   (NOTE: Bay windows come in a variety of designs. The bay-window projection may have squared sides, be one continuous curve, or have any number of sides set at angles to one another, usually with the same angle between sides and a window in each side.)

   B. Bow window — Curved bay window

   C. Dormer — Structure built out from a sloping roof and usually including one or more windows

   D. Zero-clearance fireplace — Insulated fireplace that needs no clearance between fireplace and framing members

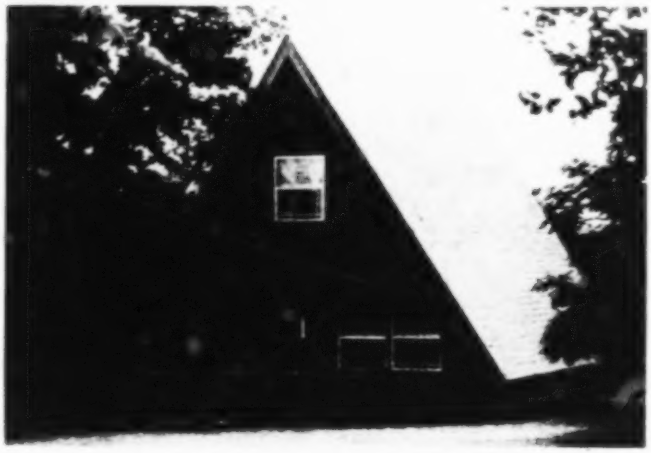
   E. Deck — Unsheltered floor of wood construction

   F. Balcony — Deck that is located above ground level but has no direct access (such as stairs) from ground level

II. Types of special house designs (Figures 1-10)

   A. A-frame

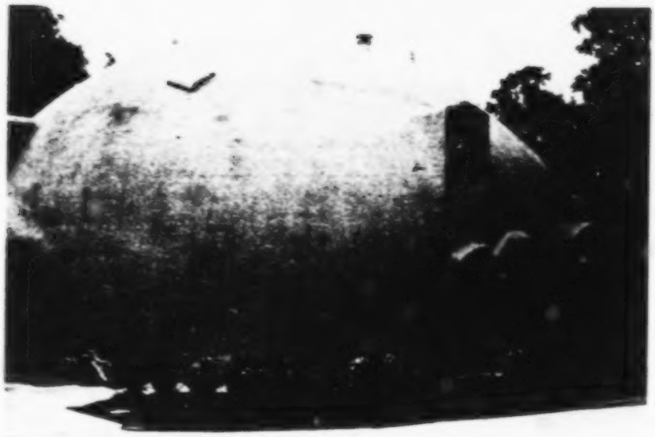
FIGURE 1



INFORMATION SHEET

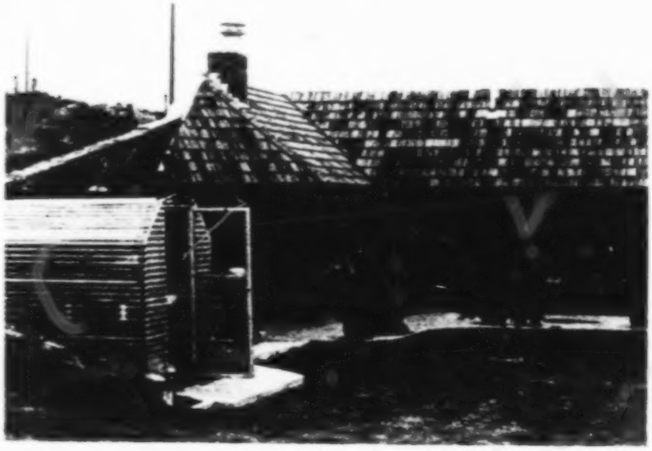
B. Dome

FIGURE 2



C. Earth-sheltered

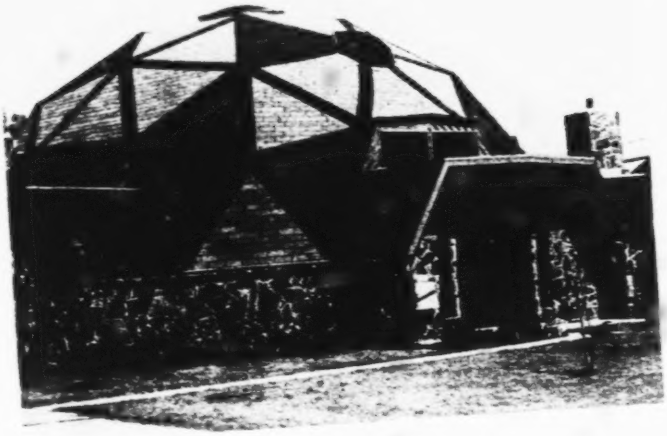
FIGURE 3



INFORMATION SHEET

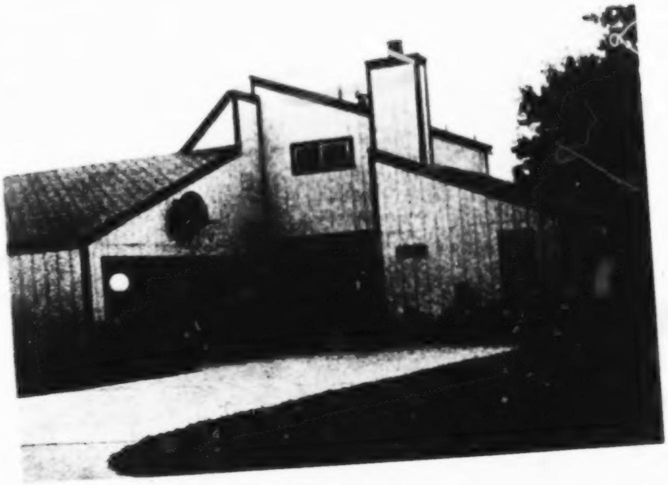
D. Geodesic

FIGURE 4



E. Monopitched

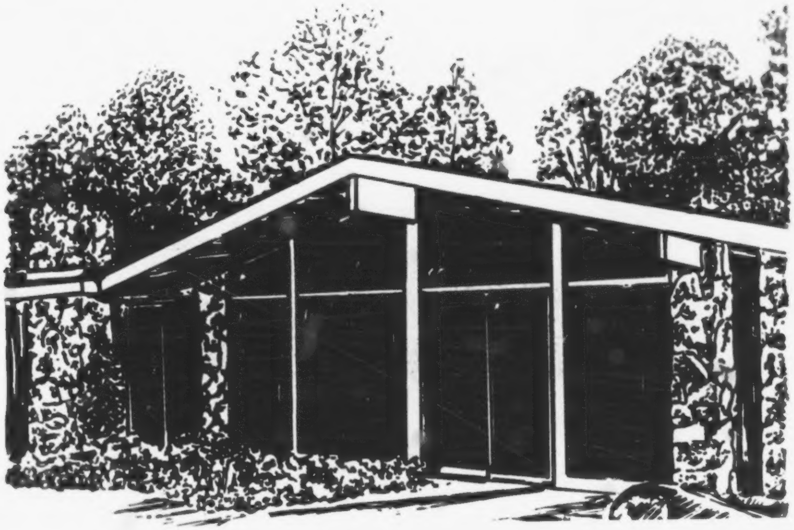
FIGURE 5



INFORMATION SHEET

F. Post-and-beam

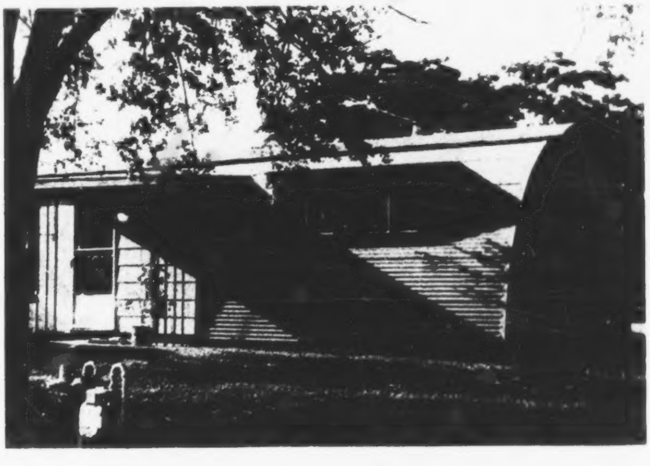
FIGURE 6



Used with permission of Scholz Homes, Incorporated, Toledo, Ohio.

G. Cylindrical paraboloid

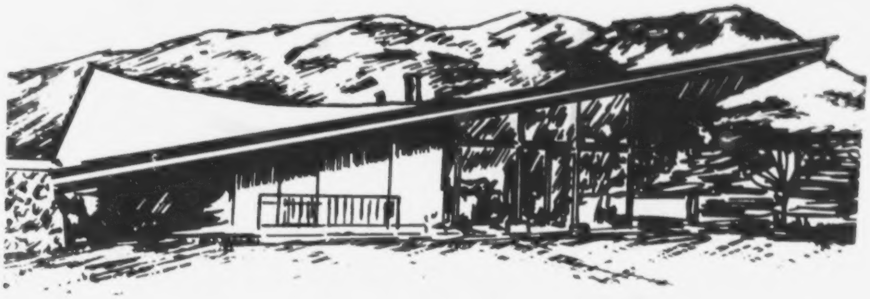
FIGURE 7



INFORMATION SHEET

H. Hyperbolic paraboloid

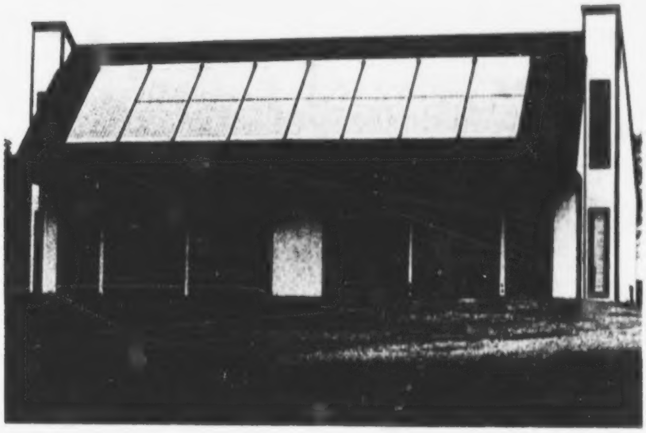
FIGURE 8



I. Solar

(NOTE: Solar houses may be passive, active, or combination in design.)

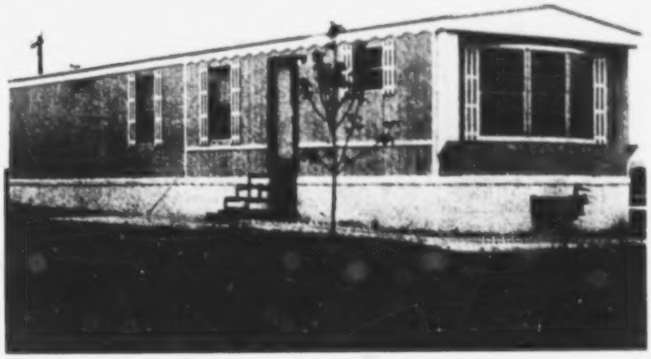
FIGURE 9



INFORMATION SHEET

J. Manufactured

FIGURE 10



III. Special framing projects

A. Bay window (Figures 11 and 12)

FIGURE 11

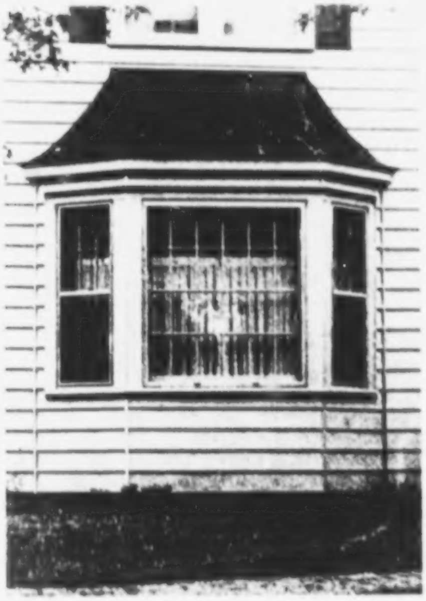
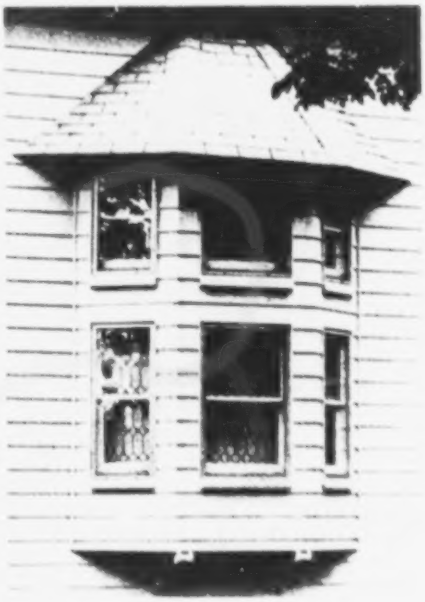


FIGURE 12



INFORMATION SHEET

B. Bow window (Figures 13 and 14)

FIGURE 13

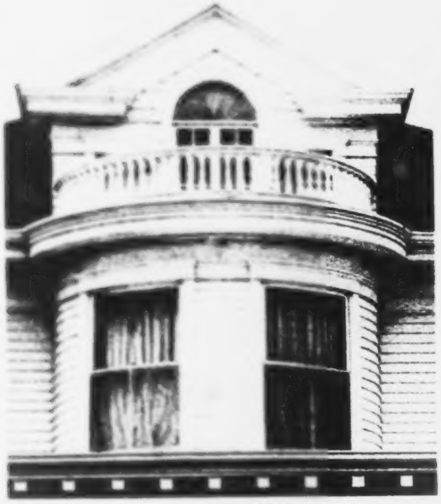
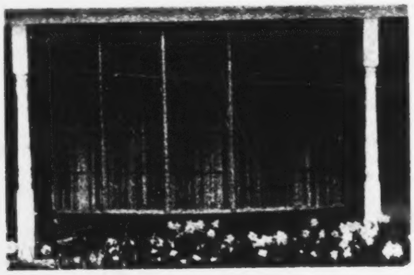


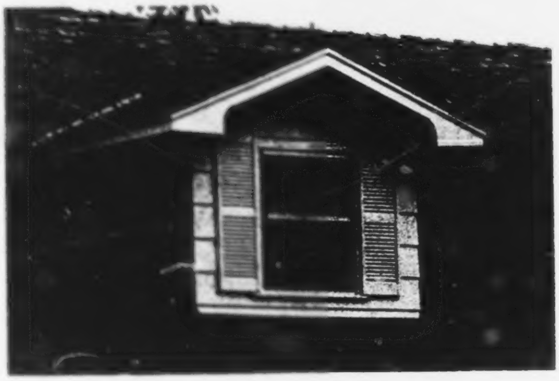
FIGURE 14



C. Dormer (Figures 15 and 16)

1. Gable

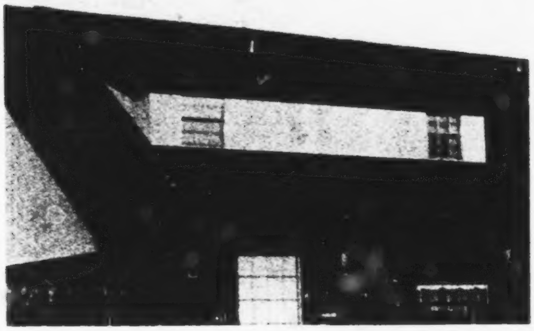
FIGURE 15



INFORMATION SHEET

2. Shed

FIGURE 16



D. Porch (Figures 17 and 18)

FIGURE 17

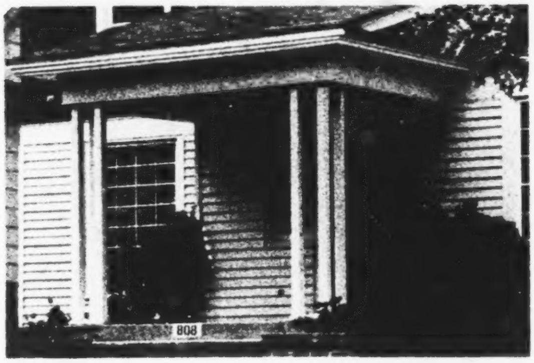
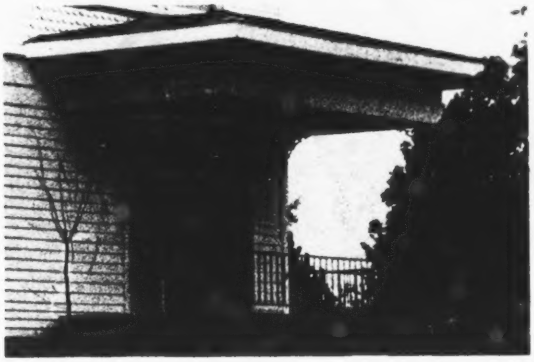


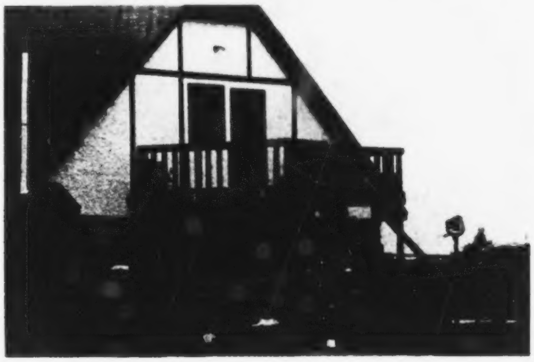
FIGURE 18



INFORMATION SHEET

E. Deck (Figure 19)

FIGURE 19



F. Balcony (Figures 20 and 21)

FIGURE 20

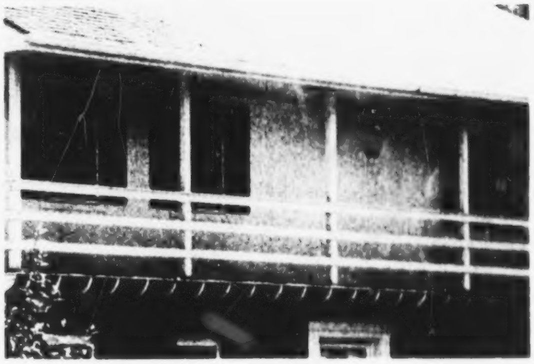
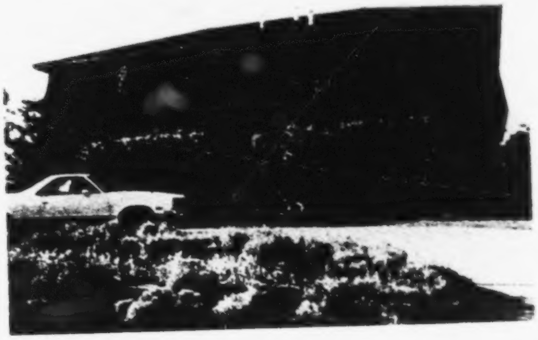


FIGURE 21

INFORMATION SHEET

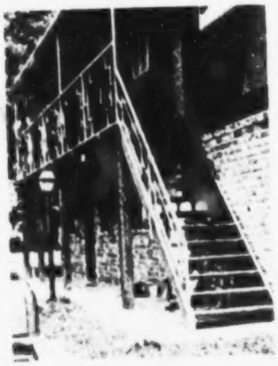
G. Mansard roof (Figure 22)

FIGURE 22



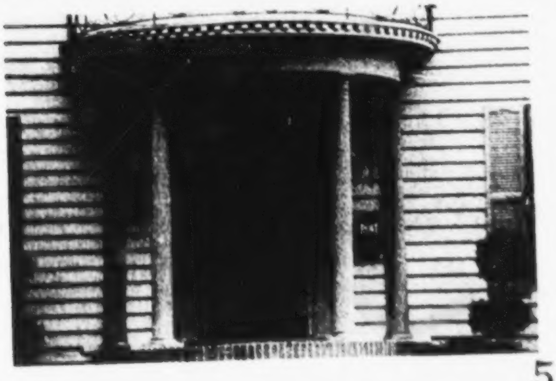
H. Stairs (Figure 23)

FIGURE 23



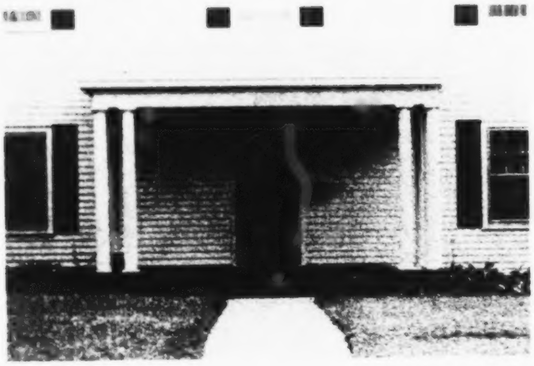
I. Entry (Figures 24 and 25)

FIGURE 24



INFORMATION SHEET

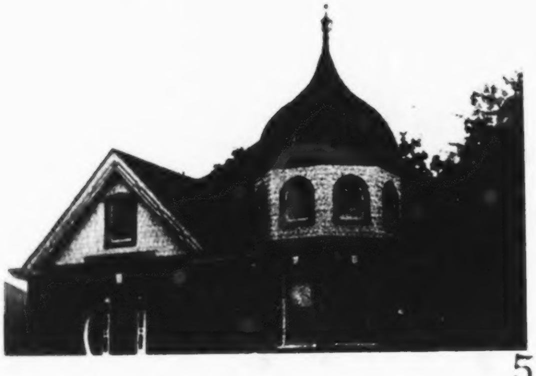
FIGURE 25



J. Tower (turret) (Figures 26 and 27)

FIGURE 26

FIGURE 27



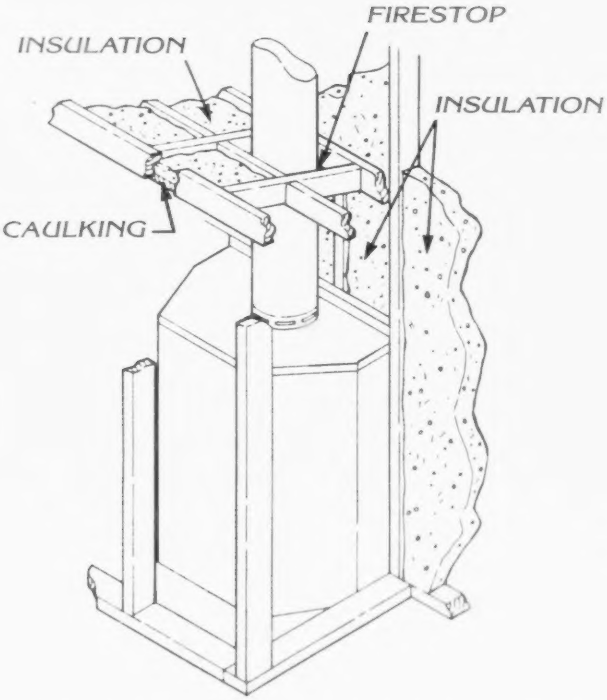
INFORMATION SHEET

K. Zero-clearance fireplace (Figures 28 and 29)

FIGURE 28

EXAMPLE:

FIGURE 29


FIRESTOP
INSULATION
INSULATION
CAULKING

Figures 28 and 29 courtesy of The Majestic Company, an American-Standard Company, Huntington, Indiana.

INFORMATION SHEET

IV. Terms associated with stairs

A. Staircase — Flight of stairs with supporting framework, including casing, baluster, and handrail

B. Stairwell — Framed opening in which staircase is built

C. Tread — Upper horizontal member of a step

D. Riser — Vertical member between stair treads

E. Run — Horizontal distance from a point at head of staircase to outside of last riser

F. Line of flight — Angle of ascent of a staircase

G. Headroom — Space between tread of stair and ceiling directly above that tread

H. Stringer — Inclined support for a flight of stairs

I. Nosing — Rounded edge of tread that projects over riser

J. Newel-post — Main post that is usually located at bottom of staircase but is sometimes located at top of staircase or at landings

K. Handrail (baluster rail) — Support used by people climbing up or down stairs

L. Baluster — Vertical member that supports handrail

M. Landing — Platform introduced at some point in stairway to change direction of stairway or to break the run

N. Open stair — Stairs with at least one side open to room

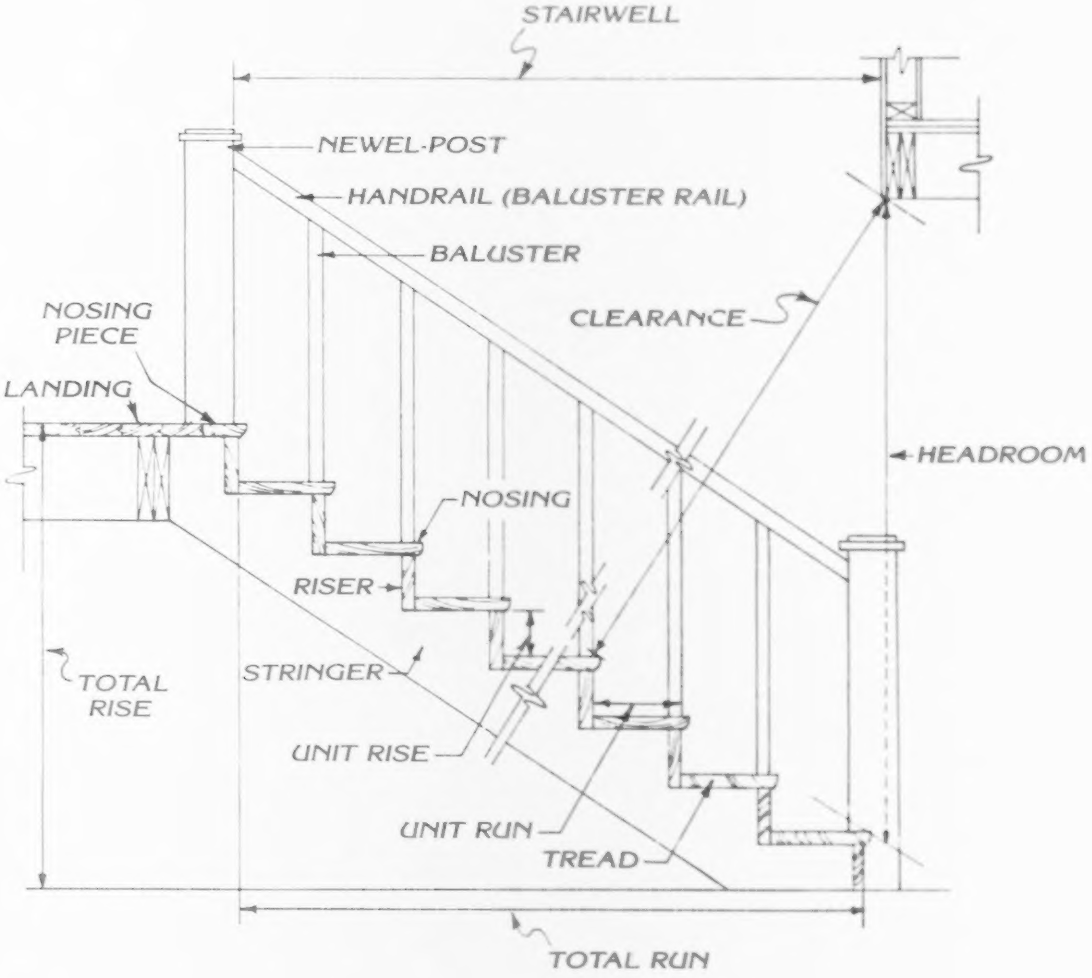
O. Housed (closed) stair — Stairs with stringers housed between two walls

(NOTE: Stairs that are completely or partially open on one side are called *semi-housed stairs.*)

INFORMATION SHEET

V. Parts of a staircase (Figure 30)

FIGURE 30

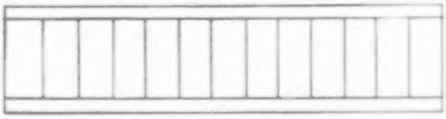

STAIRWELL
NEWEL-POST
HANDRAIL (BALUSTER RAIL)
BALUSTER
NOSING PIECE
LANDING
CLEARANCE
HEADROOM
NOSING
RISER
STRINGER
TOTAL RISE
UNIT RISE
UNIT RUN
TREAD
TOTAL RUN

INFORMATION SHEET

VI. Basic types of stairs (Figures 31-36)

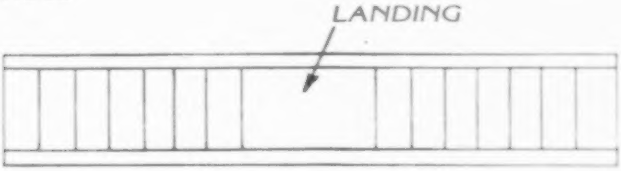
A. Straight flight

FIGURE 31



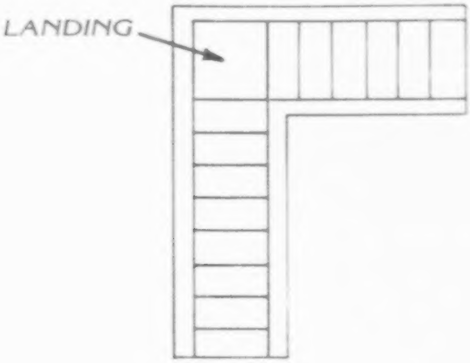
B. Straight flights with landing

FIGURE 32



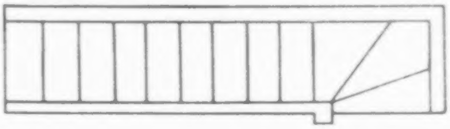
C. Ninety-degree flights with landing

FIGURE 33



D. Ninety-degree flight with winders

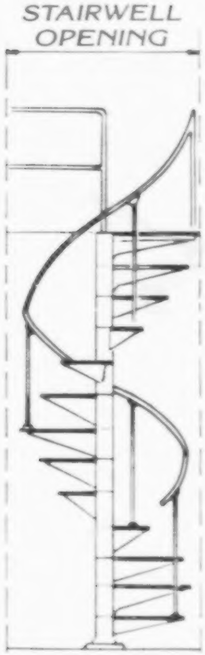
FIGURE 34



INFORMATION SHEET

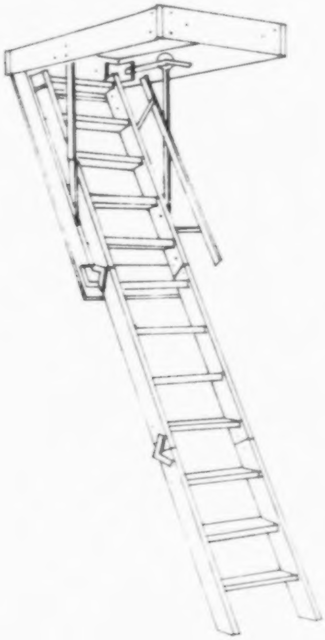
E. Circular

FIGURE 35



F. Disappearing unit

FIGURE 36



VII. Factors that you must consider when building a staircase

(NOTE: Refer to local building codes.)

A. Tread width

(NOTE: The minimum width of a tread is 3 feet, but 4 feet is the preferred width.)

B. Headroom

(NOTE: The minimum headroom allowance for a main stair is 6'-8"; the minimum allowance for a basement or service stair is 6'-4".)

C. Line of flight

(NOTE: The preferred line-of-flight angle for a stair is from 30 to 35 degrees.)

D. Unit rise

(NOTE: To be comfortable, the unit rise should be from 7 to 8 inches, but all risers in a stair must be of uniform height.)

INFORMATION SHEET

E. Unit run

(NOTE: To be comfortable, the unit run should be from 9 to 11 inches, but all treads in a stair must be of uniform width.)

F. Handrail height

(NOTE: The distance from the top of the handrail to the top of a tread at the middle should be no less than 32 inches and no greater than 36 inches.)

VIII. Rules of thumb for unit rise and unit run

A. Total of one riser and one tread should not be less than 16 inches or more than 18 inches

B. Unit rise should be 7 to 8 inches

C. Unit run should be 9 to 11 inches

(NOTE: As the rise increases, the run must decrease proportionally. Treads and risers must be the same size as other treads and risers for any given set of stairs.)

IX. Calculating number and size of risers and treads for a stair

A. Risers

1. Determine total rise of stair (in inches)

   (NOTE: The total rise of a stair is measured from the finished floor of the lower level to the top of the finished floor of the upper level.)

2. Divide total rise of stair by seven and round back to nearest whole number to find the number of risers needed

   (NOTE: Seven inches is the minimum height of a riser.)

   EXAMPLE: If the total rise is $7'$-$10\frac{1}{4}''$ or $94\frac{1}{4}''$,

   $94\frac{1}{4}'' \div 7 = 13.46$ or $13\frac{7}{16}$,

   $\frac{7}{16}$ will not make a full riser, so round back to thirteen full risers.

3. Divide total rise by number of risers to find height of each riser (unit rise)

   EXAMPLE: $94\frac{1}{4}'' \div 13 = 7\frac{1}{4}''$

   There would be thirteen risers of $7\frac{1}{4}$ inches each.

INFORMATION SHEET

B. Treads

1. Determine total run of stair (in inches)

   (NOTE: The total run of the stair is the horizontal distance from a point at the head of the stair to the outside edge of the last riser.)

2. Subtract one from the number of risers to find number of treads

   (NOTE: There is always one fewer treads than there are risers.)

3. Divide total run by number of treads to find width of each tread (unit run)

   EXAMPLE: If the total run for a stair is 9′-9″ or 117″ and there are 12 risers,

   117″ ÷ 12 = 9.75″ or 9¾″ width of each tread (unit run),

   There will be twelve treads of 9¾ inches each.

X. Estimating material for housed stairs

(NOTE: Check specifications for types and dimensions of material.)

A. Stringers

1. Determine stringer length needed

   a. Determine number of risers and number of treads

   b. Determine unit rise and unit run

   c. Locate unit rise on tongue of framing square and unit run on the framing square blade and attach stair gauges to the framing square (See Figure 37)

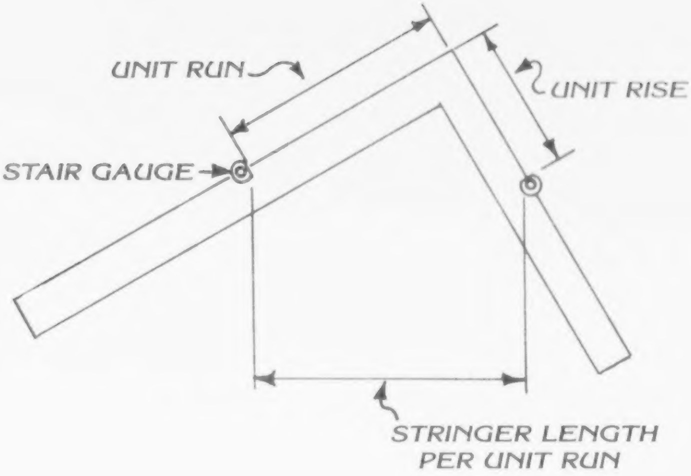
   d. Determine stringer length per unit run

      (NOTE: The diagonal measurement from the unit run to the unit rise on the framing square is the stringer length per unit run. See Figure 37.)

INFORMATION SHEET

EXAMPLE:

FIGURE 37



e. Multiply stringer length per unit run (in inches) by number of treads to find length of stringer (in inches)

f. Divide by twelve to find length of stringer in feet

g. Add 2 feet to length of stringer to allow for waste

EXAMPLE: If the unit rise is 7¼ inches, unit run is 9 inches, the number of treads is twelve, and the stringer length per unit run equals 12 inches,

12 × 12 = 144″,

144 ÷ 12 = 12′ + 2′ = 14′,

Stringer material will be 14 feet long.

2. Determine number of stringers needed by checking specifications

(NOTE: A minimum of two stringers are needed for stairs 36 inches wide; stairs over 36 inches should have additional stringers. The rule of thumb is to use stringers every 36 inches when 1½-inch thick material is used on treads.)

INFORMATION SHEET

B. Treads

1. Determine width of treads

   (NOTE: Width of tread is unit run plus amount of nosing desired.)

2. Determine thickness of treads

   (NOTE: Treads for basement and service stairs are usually made from 2-inch material.)

3. Determine length of treads

   (NOTE: For housed stairs, the length of treads will be the distance between the two walls.)

4. Multiply length of tread by number of treads to determine length of material needed

   EXAMPLE: If unit run is 9 inches, nosing is $1\frac{1}{4}$ inch, width of stairwell is 36 inches, and the number of treads is twelve, and it will be necessary to use 2×12s for the treads,

   3′ × 12 = 36′ of 2×12s,

   Three 2 × 12s × 12′ will make twelve 3-foot treads.

C. Risers

1. Determine height of risers

   (NOTE: Unit rise will be the height of the risers.)

2. Determine thickness of risers

   (NOTE: Risers are usually made from 1-inch material.)

3. Determine length of risers

   (NOTE: For a housed stair, the length will be the distance between the two walls.)

4. Multiply length of riser by number of risers to find length of material needed

   EXAMPLE: If unit rise is $7\frac{1}{4}$ inches, width of stairwell is 36 inches, and number of risers is thirteen, and it will be necessary to use 1×8s for the risers,

   3′ × 13 = 39′ of 1×8s,

   Two 1 × 8s × 12′ and one 1 × 8 × 16′ will make thirteen

   3-foot risers.

INFORMATION SHEET

D. Nails

1. Use 16d casing nails for treads

   (NOTE: It takes approximately 3 pounds of 16d casing nails for a basement stair.)

2. Use 16d box nails for stringers

   (NOTE: It takes approximately 2 pounds of 16d box nails for a basement stair.)

3. Use 8d box nails for risers

   (NOTE: It takes approximately 2 pounds of 8d box nails for a basement stair.)

E. Baluster rail

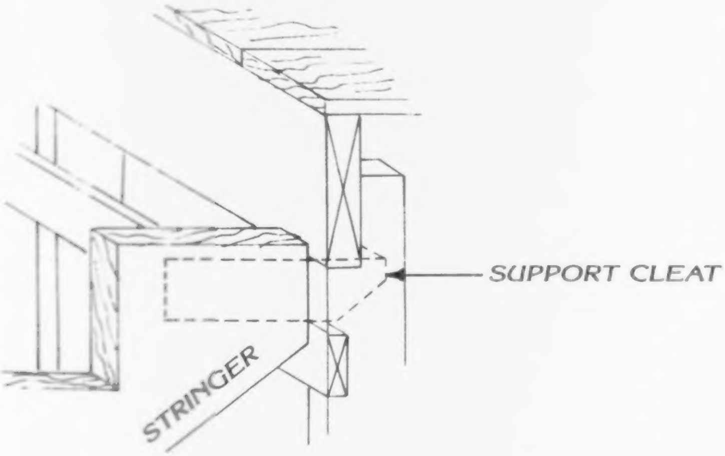
1. Use one baluster rail on each side of staircase

2. Cut baluster same length as stringers

XI. Methods used to secure stringers (Figures 38-40)

A. Ledger strip

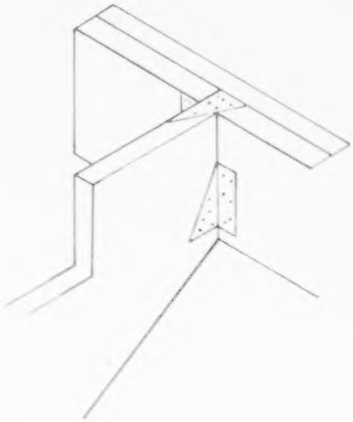
FIGURE 38



INFORMATION SHEET

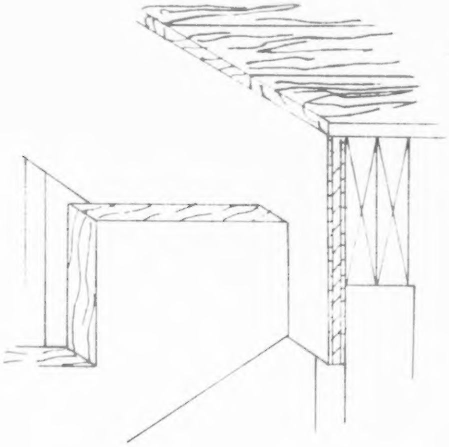
B. Hangers

FIGURE 39



C. Nails (nailed from rear)

FIGURE 40



SPECIAL FRAMING
UNIT IV
STUDENT SUPPLEMENT #1 — STAIR DATA CHART

NOTES

1. Codes and standards used on this page:
   ANSI = American National Standards Institute.
   BOCA = Building Officials and Code Administrators.
   NBC = National Building Code.
   SBCC = Southern Building Code Congress.
   UBC = Uniform Building Code.
2. T = tread; R = riser.
3. Maximum height between landings is 12 ft (most codes).

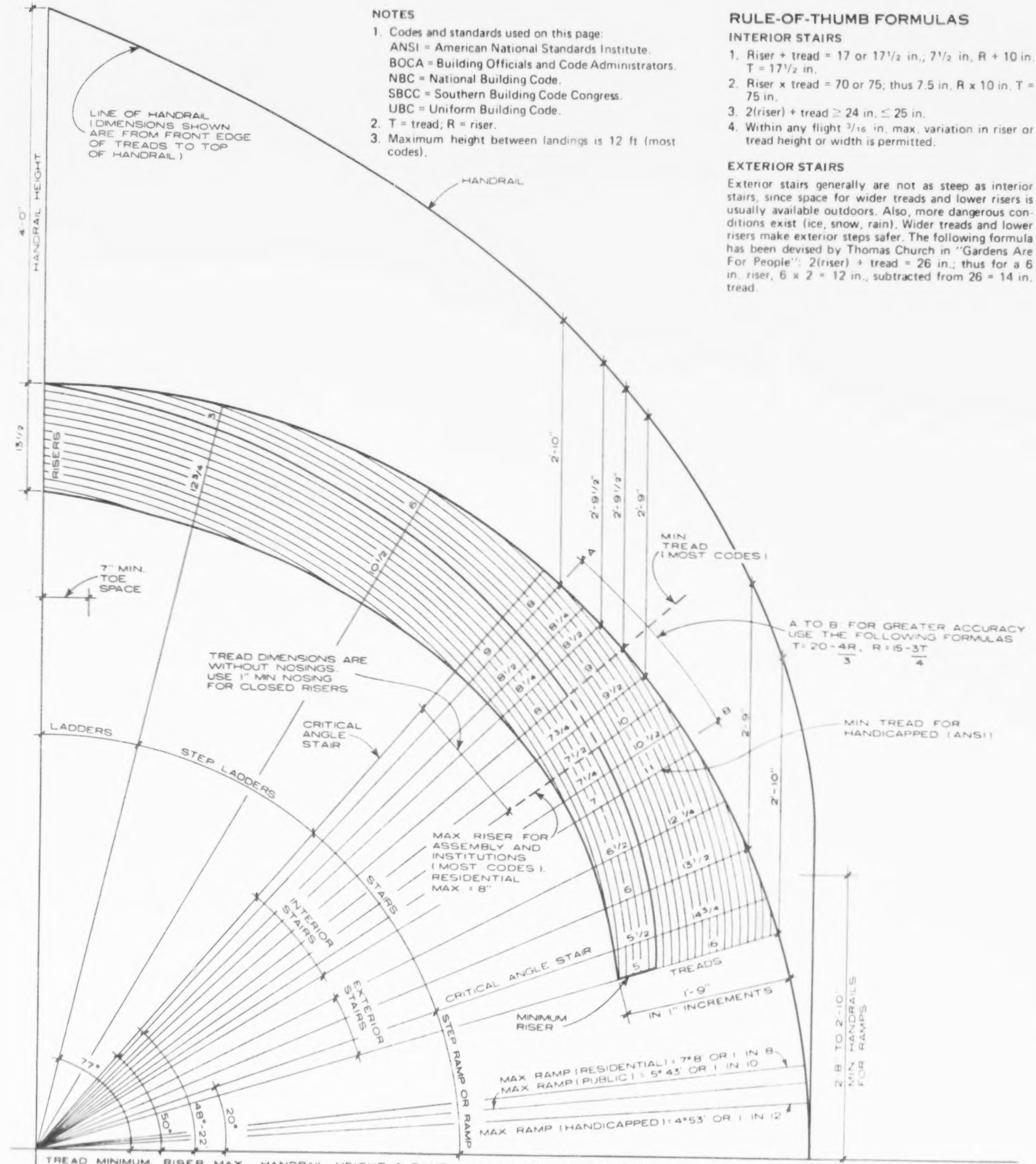
RULE-OF-THUMB FORMULAS

INTERIOR STAIRS

1. Riser + tread = 17 or 17½ in.; 7½ in. R + 10 in. T = 17½ in.
2. Riser x tread = 70 or 75; thus 7.5 in. R x 10 in. T = 75 in.
3. 2(riser) + tread ≥ 24 in. ≤ 25 in.
4. Within any flight 3/16 in. max. variation in riser or tread height or width is permitted.

EXTERIOR STAIRS

Exterior stairs generally are not as steep as interior stairs, since space for wider treads and lower risers is usually available outdoors. Also, more dangerous conditions exist (ice, snow, rain). Wider treads and lower risers make exterior steps safer. The following formula has been devised by Thomas Church in "Gardens Are For People": 2(riser) + tread = 26 in.; thus for a 6 in. riser, 6 x 2 = 12 in., subtracted from 26 = 14 in. tread.


LINE OF HANDRAIL (DIMENSIONS SHOWN ARE FROM FRONT EDGE OF TREADS TO TOP OF HANDRAIL)
HANDRAIL
4'-0" HANDRAIL HEIGHT
13½
RISERS
3
12¾
6
10½
2'-10"
2'-9½"
2'-9½"
2'-9"
MIN TREAD (MOST CODES)
A
B
A TO B: FOR GREATER ACCURACY USE THE FOLLOWING FORMULAS T = 20 - 4R/3, R = 15 - 3T/4
2'-9"
2'-10"
MIN. TREAD FOR HANDICAPPED (ANSI)
7" MIN. TOE SPACE
TREAD DIMENSIONS ARE WITHOUT NOSINGS. USE 1" MIN NOSING FOR CLOSED RISERS
CRITICAL ANGLE STAIR
8
8¼
8½
9
9½
10
10½
11
12¼
13½
14¾
16
8½
8¼
8
7¾
7½
7¼
7
6½
6
5½
5
MAX. RISER FOR ASSEMBLY AND INSTITUTIONS (MOST CODES). RESIDENTIAL MAX. = 8"
LADDERS
STEP LADDERS
STAIRS
INTERIOR STAIRS
EXTERIOR STAIRS
CRITICAL ANGLE STAIR
TREADS
1'-9" IN 1" INCREMENTS
MINIMUM RISER
STEP RAMP OR RAMP
MAX. RAMP (RESIDENTIAL): 7°8' OR 1 IN 8
MAX. RAMP (PUBLIC): 5°43' OR 1 IN 10
MAX. RAMP (HANDICAPPED): 4°53' OR 1 IN 12
2'-8" TO 2'-10" MIN. HANDRAILS FOR RAMPS
77°
50°
48°-22'
20°

TREAD MINIMUM, RISER MAX., HANDRAIL HEIGHT & RAMP INCLINE ARE GOVERNED BY LOCAL OR STATE CODES. CHECK LOCAL CODE.

TREADS AND RISERS

Paul Vaughan, AIA, Charleston, West Virginia

RC - 307-D

Stair data used with permission of *Architecture*, Washington, D.C., as seen in *Architectural Graphic Standards*, 7th edition.

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SPECIAL FRAMING
UNIT IV

ASSIGNMENT SHEET #1 — ESTIMATE MATERIAL FOR A HOUSED STAIR

NAME ______________________ SCORE __________

One of the most common special framing projects encountered by a residential carpenter is the building of stairs. Thus a carpenter must understand the design and material requirements for stair construction. Estimate the material needed to construct a housed stair to fit the stairwell illustrated below. Write the correct answers in the blanks.

A. Number of stringers = __________

B. Stringer length = __________

C. Tread length = __________

D. Number of treads = __________

E. Riser length = __________

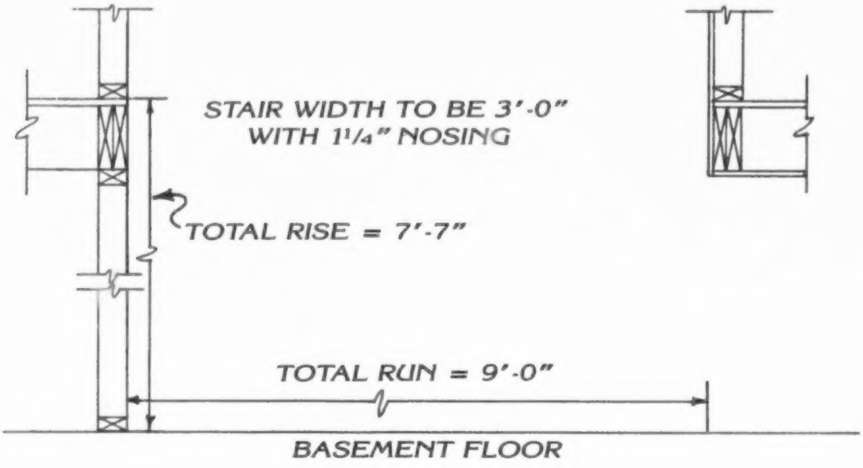
F. Number of risers = __________

G. Unit rise = __________

H. Unit run = __________

I. Material order

1. Stringers (2 × 12) = __________
2. Riser (1 × 8) = __________
3. Treads (2 × 12) = __________


STAIR WIDTH TO BE 3'-0"
WITH 1¼" NOSING
TOTAL RISE = 7'-7"
TOTAL RUN = 9'-0"
BASEMENT FLOOR

SPECIAL FRAMING
UNIT IV

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

A. 2

B. 14′

C. 3′

D. 12

E. 3′

F. 13

G. 7″

H. 9″

I. 1. Two 2″×12″×14′
   (NOTE: Answer could vary according to variations in lengths of lumber.)
   2. Two 1″×8″×12′
   One 1″×8″×16′
   3. Three 2″×12″×12′

SPECIAL FRAMING
UNIT IV

JOB SHEET #1 — CONSTRUCT A HOUSED STAIR

I. Tools and materials

A. Folding rule or steel tape

B. Framing square

C. Power handsaw and extension cord

D. Handsaw

E. 3-foot level

F. Claw hammer

G. Stair gauges

H. 2×12s for stringers

I. 2×12s for treads

J. 1×8s for risers

K. Handrail and brackets

L. 16d casing nails, 16d box nails, and 8d box nails

M. Plans provided by instructor

N. Manufacturer's instructions for handrail hardware

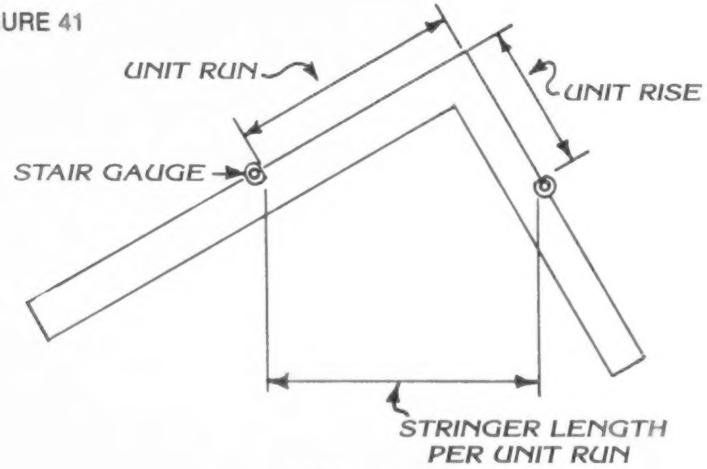
II. Procedure

(NOTE: For a housed stair, you must allow room for the wall material. If drywall is used, drywall the walls first or furr out the stringers from the wall.)

A. Lay out stringers

1. Check plans and determine number of risers and treads
2. Check plans and determine unit rise and unit run
3. Check plans and determine number of stringers
4. Place stair gauges on framing square at the exact unit rise and unit run (Figure 41)

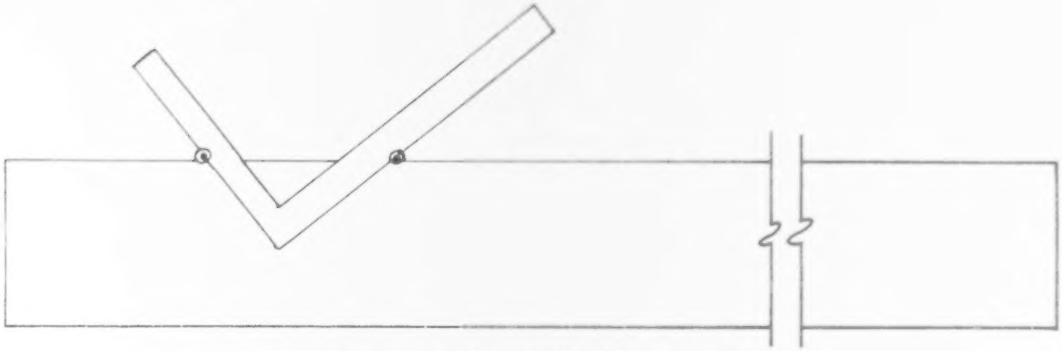
FIGURE 41



JOB SHEET #1

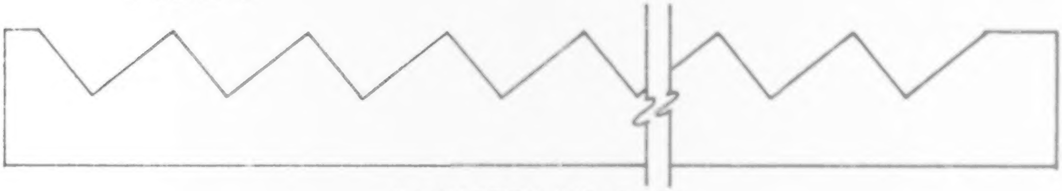
5. Lay out tread and riser locations on stringer material (Figures 42 and 43) (NOTE: Marks must be exact.)

FIGURE 42



FIRST STEP IN STRINGER LAYOUT

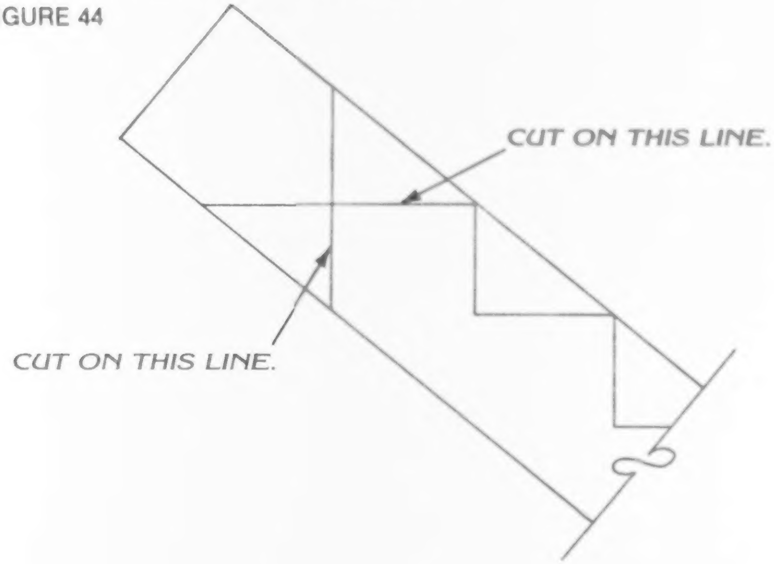
FIGURE 43



STRINGER LAID OUT

6. Lay out top-end cuts (Figure 44)

FIGURE 44


CUT ON THIS LINE.
CUT ON THIS LINE.

JOB SHEET #1

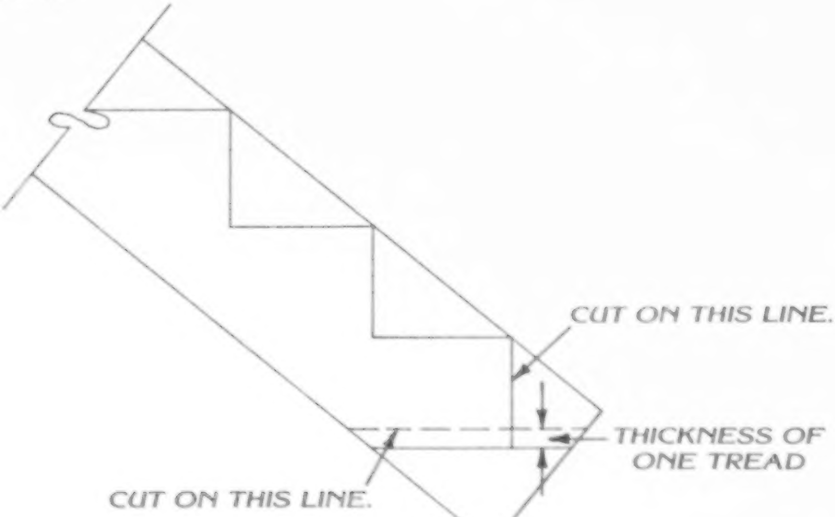
7. Lay out bottom-end cuts

   a. Lay out unit run as for other steps

   b. Shorten unit rise for bottom step by the thickness of tread

   (NOTE: The first riser is shortened so that the first step up from the floor will be the same unit rise as the remainder of the steps. See Figure 45.)

FIGURE 45


CUT ON THIS LINE.
THICKNESS OF ONE TREAD
CUT ON THIS LINE.

SHORTEN BOTTOM-END CUTS.

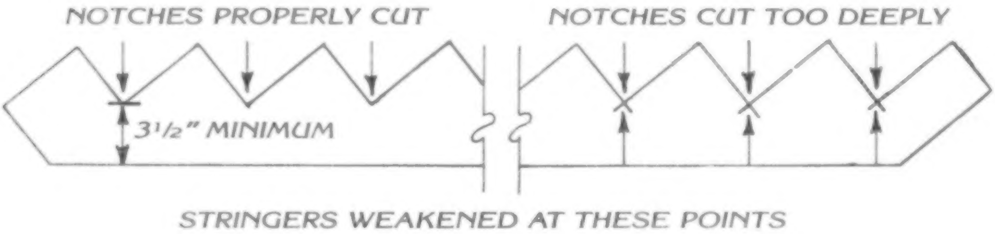
B. Cut out stringers (See Figures 46 and 47)

1. Cut into point of each notch with power handsaw

   (NOTE: Do not saw past the point of each notch as this weakens the stringer; a minimum of 3½ inches should be left from the point of the notch to the back side of the stringer.)

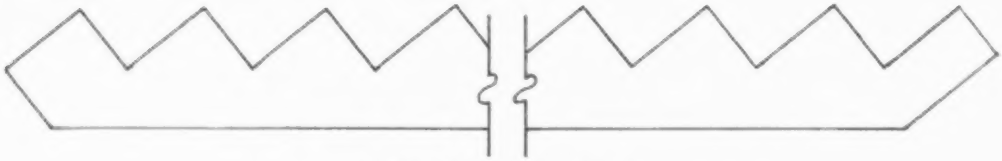
2. Finish each cut with handsaw

FIGURE 46


NOTCHES PROPERLY CUT
NOTCHES CUT TOO DEEPLY
3½" MINIMUM
STRINGERS WEAKENED AT THESE POINTS

JOB SHEET #1

FIGURE 47



STRINGER CUTOUT

C. Cut risers and treads to length and width

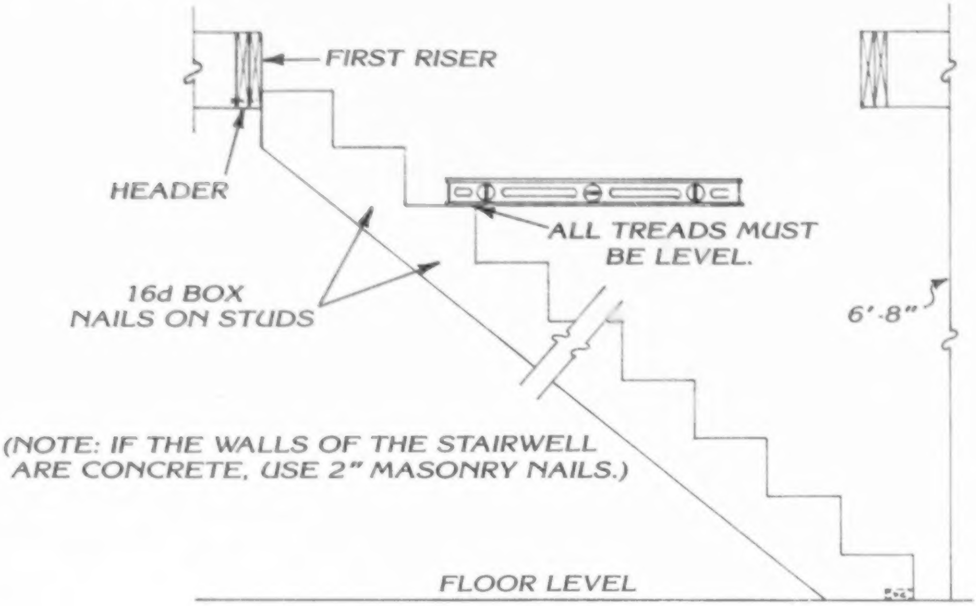
D. Assemble stairs

1. Place one stringer against wall and check for level

2. Nail stringer to wall of stairwell (Figure 48)

   (NOTE: Stringers may also be nailed to a kicker at the bottom and to header at top. Hangers, straps, or ledger strips may be used.)

FIGURE 48

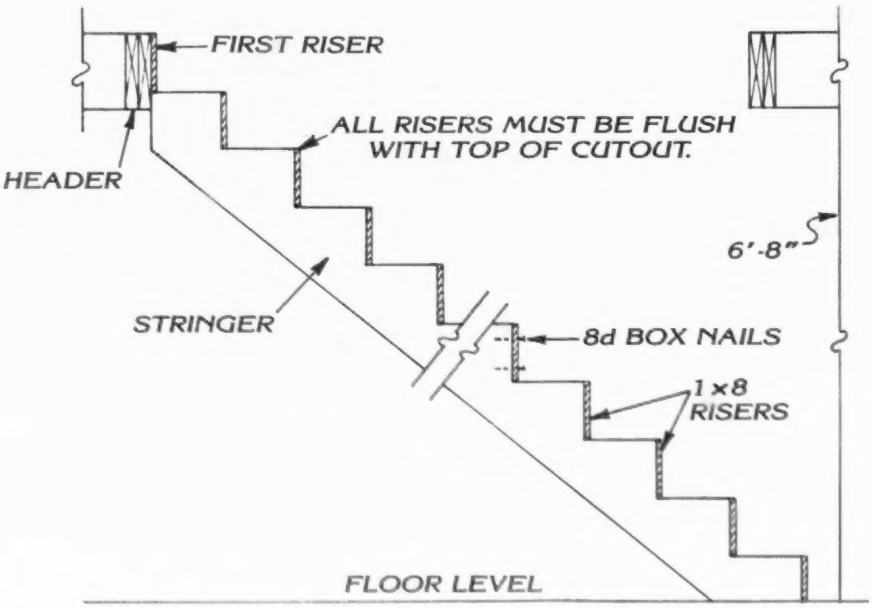

FIRST RISER
HEADER
ALL TREADS MUST BE LEVEL.
16d BOX NAILS ON STUDS
6'-8"
(NOTE: IF THE WALLS OF THE STAIRWELL ARE CONCRETE, USE 2" MASONRY NAILS.)
FLOOR LEVEL

JOB SHEET #1

3. Nail other stringer(s) in place

4. Nail risers in place (Figure 49)

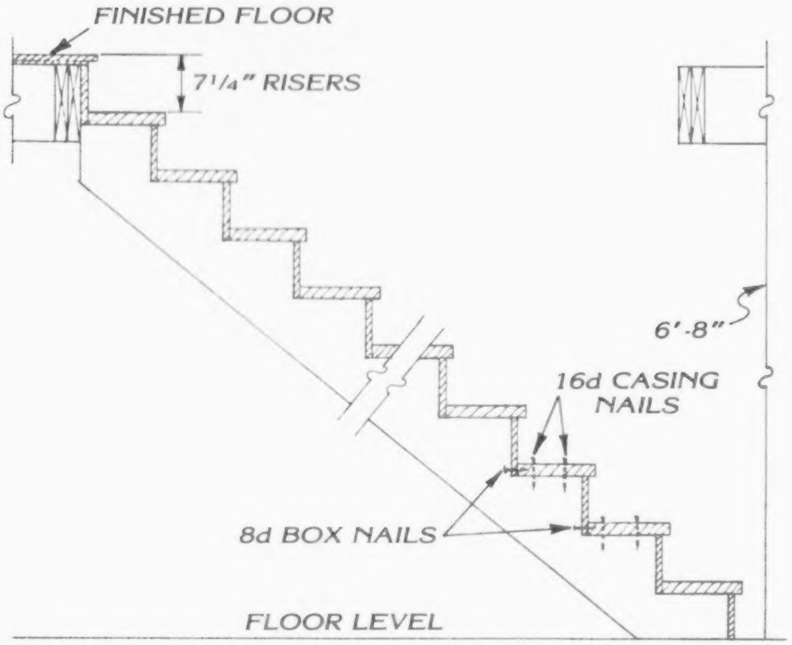
FIGURE 49


FIRST RISER
ALL RISERS MUST BE FLUSH WITH TOP OF CUTOUT.
HEADER
6'-8"
STRINGER
8d BOX NAILS
1×8 RISERS
FLOOR LEVEL

JOB SHEET #1

5. Nail treads in place (Figure 50)

FIGURE 50


FINISHED FLOOR
7¼" RISERS
6'-8"
16d CASING NAILS
8d BOX NAILS
FLOOR LEVEL

6. Install handrail

   (NOTE: Follow instructions included with handrail hardware.)

E. Clean up area and put away tools and materials

SPECIAL FRAMING
UNIT IV

TEST

NAME ______________________________ SCORE ______________

1. Match to their correct definitions terms associated with special framing. Write the correct numbers in the blanks.

_____a. Curved bay window

_____b. Window or group of windows usually supported on a foundation extending beyond main wall of structure

_____c. Deck that is located above ground level but has no direct access (such as stairs) from ground level

_____d. Structure built out from a sloping roof and usually including one or more windows

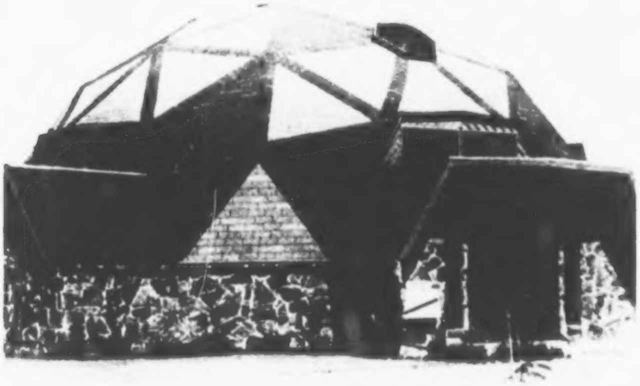
_____e. Unsheltered floor of wood construction

_____f. Insulated fireplace that needs no clearance between fireplace and framing members

1. Bay window
2. Deck
3. Bow window
4. Zero-clearance fireplace
5. Dormer
6. Balcony

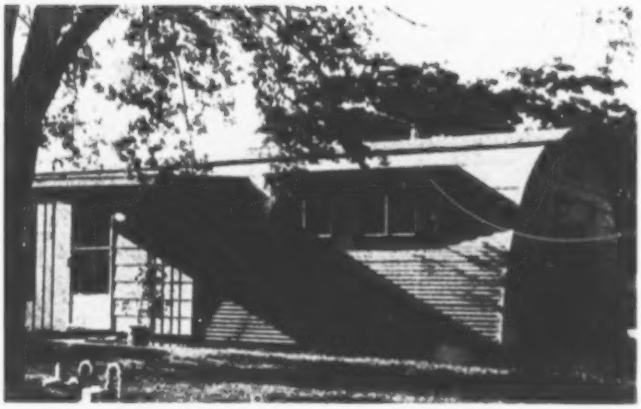
2. Identify the types of special house designs in the photographs and illustrations below and on the following pages. Write the correct names in the blanks.

Earth-sheltered
A-frame
Monopitched
Dome
Cylindrical paraboloid
Solar
Manufactured
Post-and-beam
Hyperbolic paraboloid
Geodesic

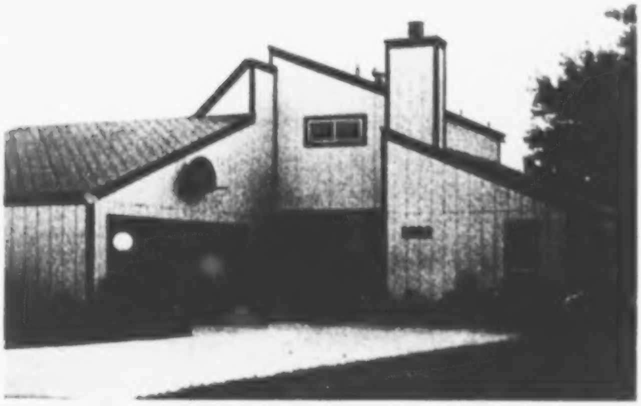


a. ______________________________

TEST

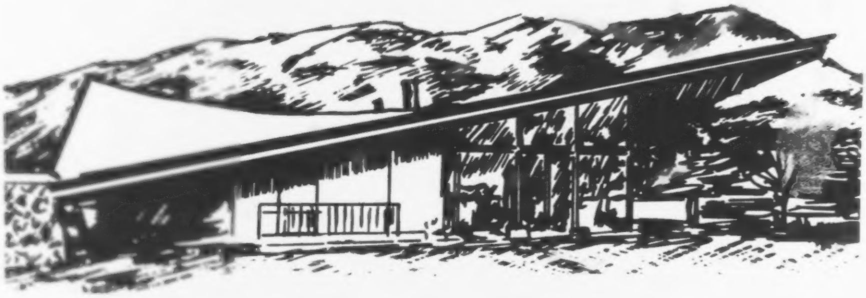


b. ____________________________

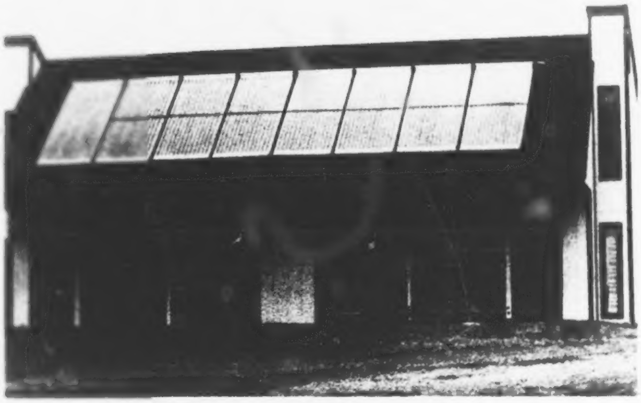


c. ____________________________

TEST

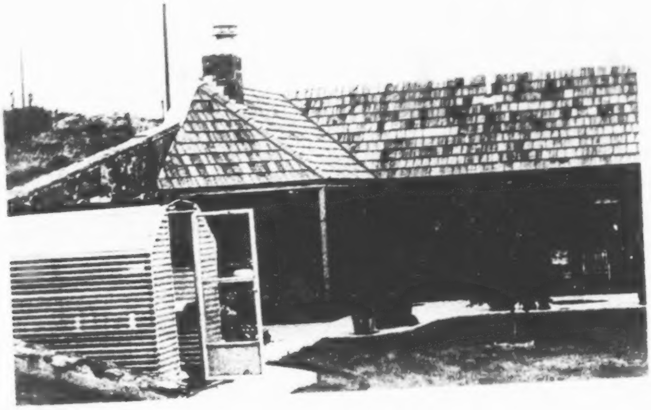


d. ______________________________

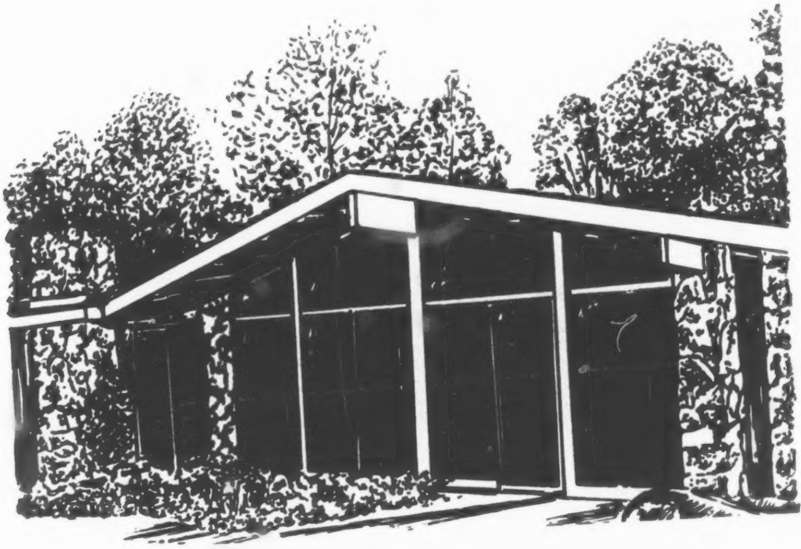


e. ______________________________

TEST

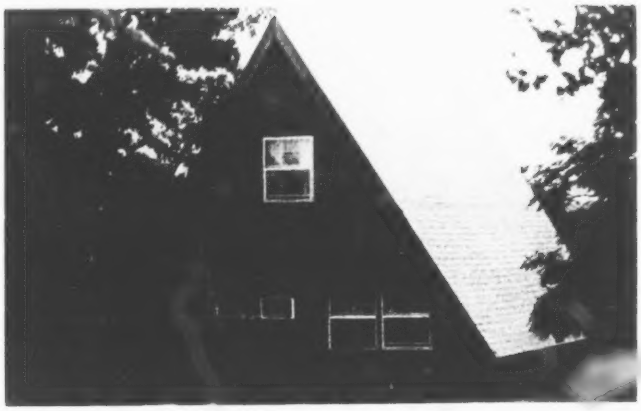


f. ______________________________

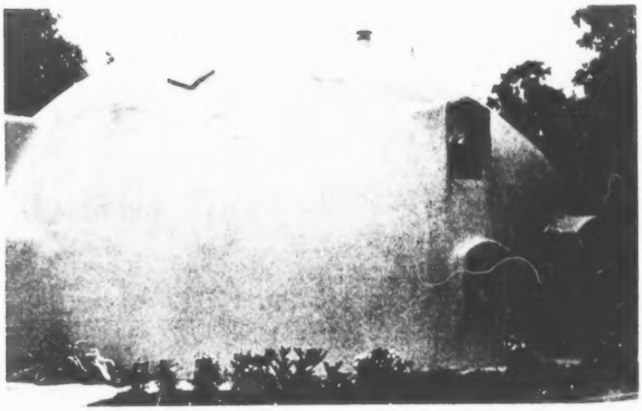


g. ______________________________

TEST

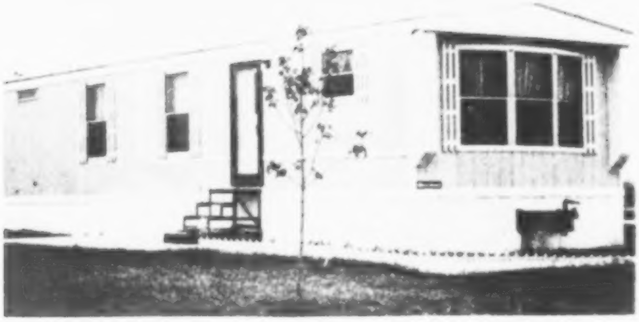


h. ______________________________



i. ______________________________

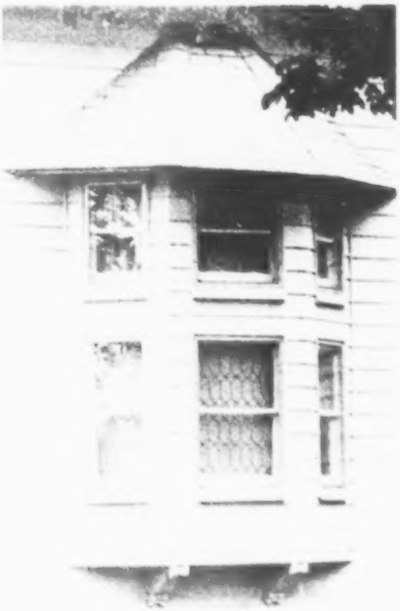
TEST



j. ______________________________

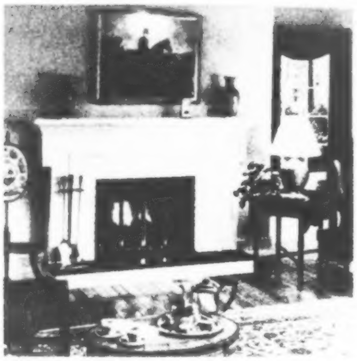
3. Identify the special framing projects illustrated below and on the following pages. Write the correct answers in the blanks. Some answers will be used more than once.

Bow window
Stairs
Entry
Porch
Balcony
Mansard roof
Gable dormer
Bay window
Zero-clearance fireplace
Shed dormer
Deck
Tower (turret)

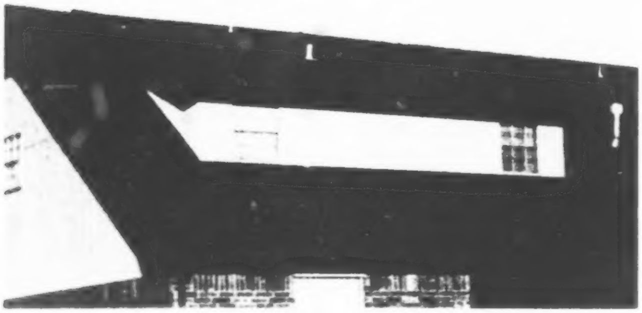


a. ______________________________

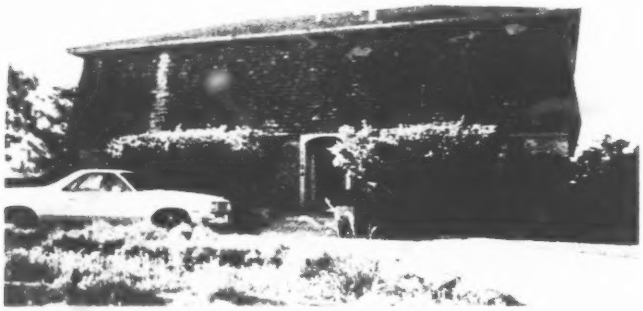
TEST



b. ______________________________

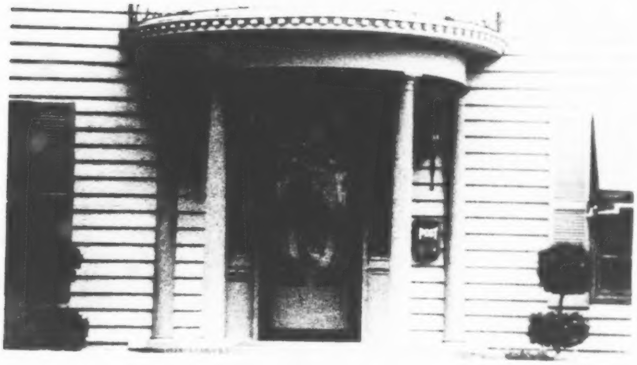


c. ______________________________

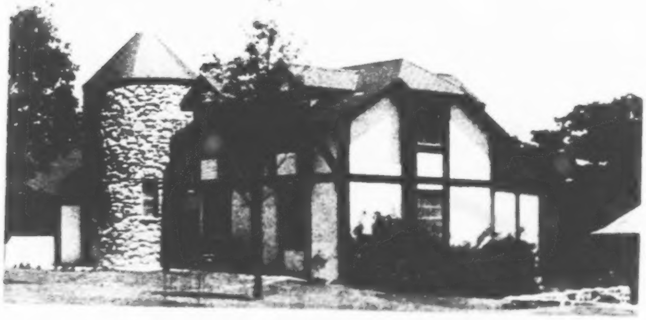


d. ______________________________

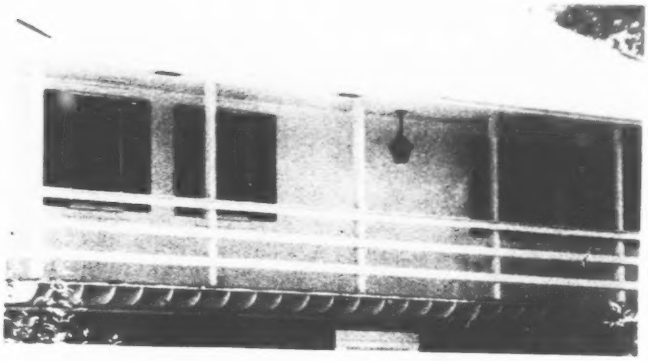
TEST



e. ________________________________

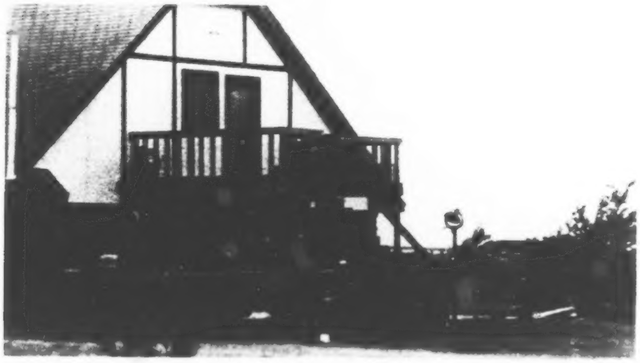


f. ________________________________

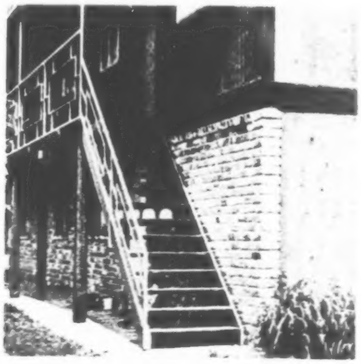


g. ________________________________

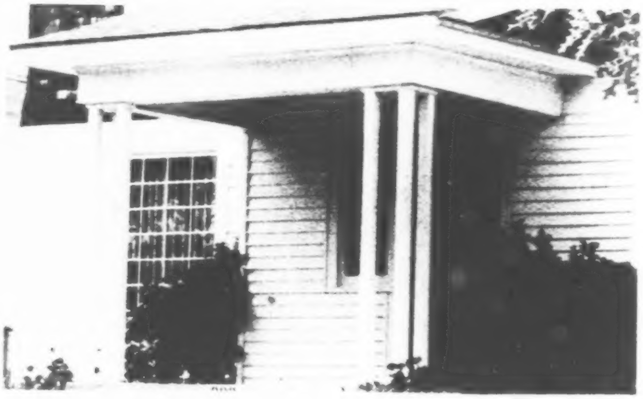
TEST



h. ______________________________

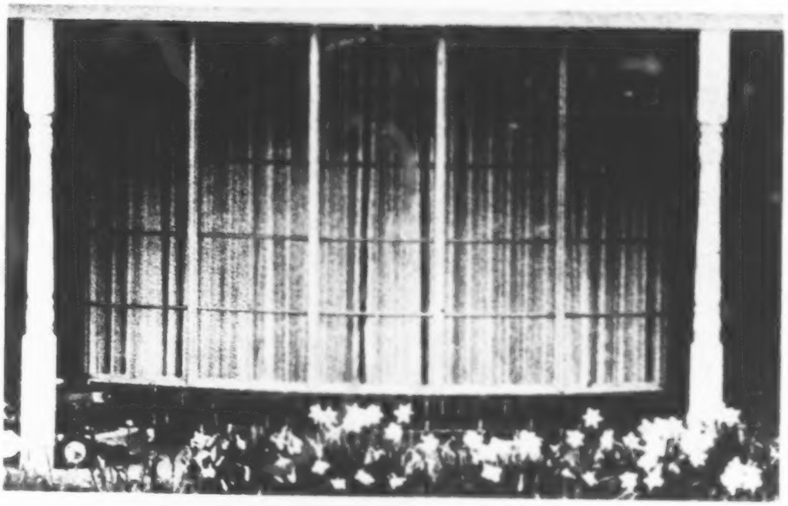


i. ______________________________

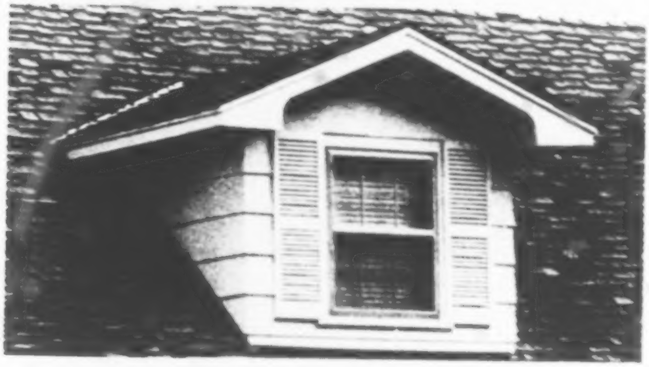


j. ______________________________

TEST

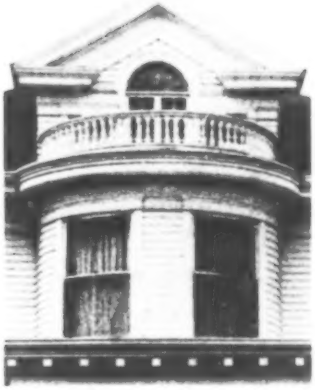


k. ______________________________



l. ______________________________

TEST



m. ______________________________

4. Match to their correct definitions terms associated with stairs. Write the correct numbers in the blanks. Definitions continue on the next page.

_____a. Inclined support for a flight of stairs

_____b. Space between tread of stair and ceiling directly above that tread

_____c. Angle of ascent of a staircase

_____d. Vertical member that supports handrail

_____e. Upper horizontal member of a step

_____f. Support used by people climbing up or down stairs

_____g. Framed opening in which staircase is built

_____h. Vertical member between stair treads

_____i. Stairs with stringers housed between two walls

_____j. Flight of stairs with supporting framework, including casing, baluster, and handrail

_____k. Platform introduced at some point in stairway to change direction of stairway or to break the run

_____l. Stairs with at least one side open to room

_____m. Main post that is usually located at bottom of staircase but is sometimes located at top of staircase or at landings

1. Headroom
2. Handrail (baluster rail)
3. Staircase
4. Newel-post
5. Stringer
6. Riser
7. Line of flight
8. Landing
9. Tread
10. Run
11. Housed (closed) stair
12. Open stair
13. Nosing
14. Baluster
15. Stairwell

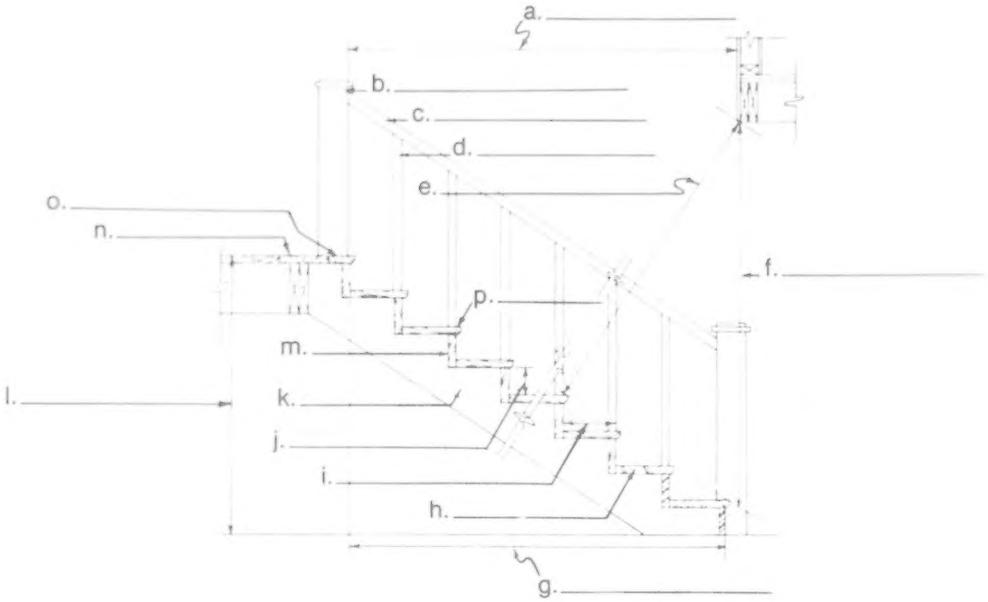
TEST

______n. Rounded edge of tread that projects over riser

______o. Horizontal distance from a point at head of staircase to outside of last riser

5. Identify the parts of the staircase illustrated below. Write the correct names in the blanks.

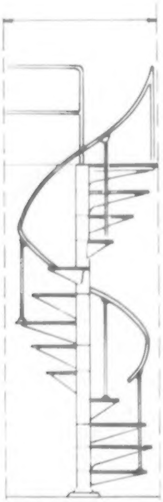
Handrail (baluster rail)
Tread
Stringer
Landing
Total run
Nosing piece
Nosing
Riser
Unit rise
Total rise
Clearance
Baluster
Unit run
Newel-post
Stairwell
Headroom



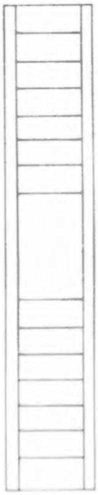
TEST

6. Identify the basic types of stairs illustrated below and on the next page. Write the correct names in the blanks.

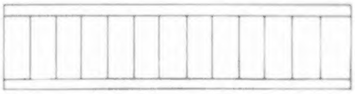
Straight flight	**Ninety-degree flights with landing**
Disappearing unit	**Ninety-degree flights with winders**
Circular	**Straight flights with landing**



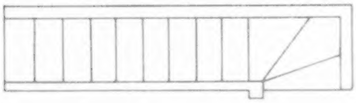
a. ______________________________



b. ______________________________

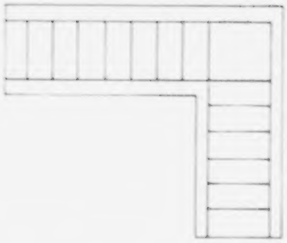


c. ______________________________

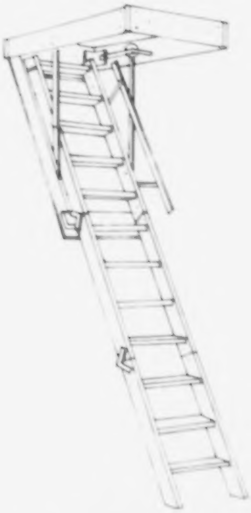


d. ______________________________

TEST



e. ______________________________



f. ______________________________

TEST

7. List three factors that you must consider when building a staircase.

   a. ____________________

   b. ____________________

   c. ____________________

8. State rules of thumb for unit rise and unit run. Write in the correct answers to complete the statements below.

   a. Total of one riser and one tread should not be less than __________ inches or more than __________ inches.

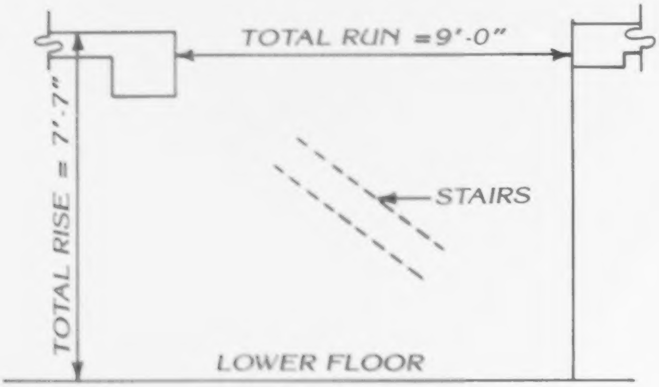
   b. Unit rise should be __________ to __________ inches.

   c. Unit run should be __________ to __________ inches.

9. Calculate number and size of risers and treads for the stair to be built in the stairwell in the illustration below. Write the correct answers in the blanks.

   a. Number and size of risers = ____________________

   b. Number and size of treads = ____________________



TEST

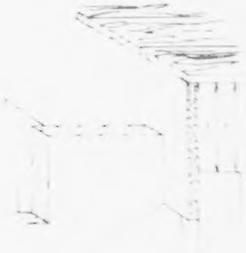
10. Estimate material needed for the stair illustrated in question #9. Write the correct answers in the blanks.

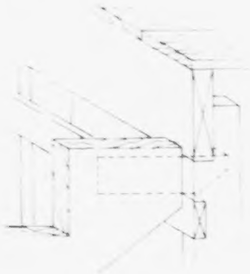
    a. Number of stringers = __________ Number and length of 2×12s = ______

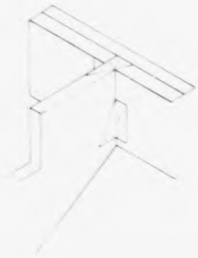
    b. Number of risers = ____________ Number and length of 1×8s = _______

    c. Number of treads = ____________ Number and length of 2×12s = ______

11. Label methods used to secure stringers.







a. ____________________ b. ____________________ c. ____________________

(NOTE: Test question 12 lists the job sheet. It is an important part of this test. If it has not been completed, check with your instructor.)

12. Demonstrate the ability to construct a housed stair.

SPECIAL FRAMING
UNIT IV

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 6
   d. 5
   e. 2
   f. 4

2. a. Geodesic
   b. Cylindrical paraboloid
   c. Monopitched
   d. Hyperbolic paraboloid
   e. Solar
   f. Earth-sheltered
   g. Post-and-beam
   h. A-frame
   i. Dome
   j. Manufactured

3. a. Bay window
   b. Zero-clearance fireplace
   c. Shed dormer
   d. Mansard roof
   e. Entry
   f. Tower (turret)
   g. Balcony
   h. Deck
   i. Stairs
   j. Porch
   k. Bow window
   l. Gable dormer
   m. Bow window

4. a. 5
   b. 1
   c. 7
   d. 14
   e. 9
   f. 2
   g. 15
   h. 6
   i. 11
   j. 3
   k. 8
   l. 12
   m. 4
   n. 13
   o. 10

5. a. Stairwell
   b. Newel-post
   c. Handrail (baluster rail)
   d. Baluster
   e. Clearance
   f. Headroom
   g. Total run
   h. Tread
   i. Unit run
   j. Unit rise
   k. Stringer
   l. Total rise
   m. Riser
   n. Landing
   o. Nosing piece
   p. Nosing

6. a. Circular
   b. Straight flights with landing
   c. Straight flight
   d. Ninety-degree flight with winders
   e. Ninety-degree flights with landing
   f. Disappearing unit

ANSWERS TO TEST

7. Answer should include any three of the following

a. Tread width	d. Unit rise
b. Headroom	e. Unit run
c. Line of flight	f. Handrail height

8. a. 16; 18
   b. 7; 8
   c. 9; 11

9. a. Thirteen risers of 7 inches each
   b. Twelve treads of 9 inches each

10. (NOTE: Answers could vary according to variations in lengths of lumber.)
    a. Three; three 14-foot 2×12s
    b. Thirteen; two 12-foot 1×8s and one 16-foot 1×8
    c. Twelve; three 12-foot 2×12s

11. a. Nails (nailed from rear)
    b. Ledger strip
    c. Hangers

12. Performance skills evaluated to the satisfaction of the instructor

CORNICES AND GABLE ENDS
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to discuss cornice and gable-end construction, build a box cornice, and apply siding to a gable end. The student will show this knowledge by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with cornices and gable ends.
2. Label types of cornice designs.
3. Identify parts of a boxed cornice.
4. Identify parts of a boxed rake section.
5. Identify types of cornice molding.
6. Label types of tail-rafter cuts.
7. Select from a list materials used for soffits.
8. Select from a list hardware and fasteners used on or with cornices.
9. Name exterior wall coverings used on gable ends.
10. Estimate material needed for cornices and gable ends.
11. Demonstrate the ability to
    a. Build a horizontal box cornice.
    b. Apply siding to a gable end.

CORNICES AND GABLE ENDS
UNIT I

SUGGESTED ACTIVITIES

I. Instructional materials
    A. Objective sheet
    B. Suggested activities
    C. Transparency masters
        1. TM #1 — Parts of a Box Cornice
        2. TM #2 — Parts of a Boxed Rake Section
        3. TM #3 — Types of Cornice Molding
        4. TM #4 — Types of Cornice Molding (Continued)
        5. TM #5 — Types of Tail-Rafter Cuts
    D. Information sheet
    E. Assignment Sheet #1 — Estimate Material Needed for Cornices and Gable Ends
    F. Answers to assignment sheet
    G. Job sheets
        1. Job Sheet #1 — Build a Horizontal Box Cornice
        2. Job Sheet #2 — Apply Siding to a Gable End
    H. Test
    I. Answers to test

II. Instructor's guide
    A. Review unit and plan presentation.
    B. Obtain materials to supplement unit.
        1. Illustrations of various types of finished cornices and gable ends
        2. Poster of the parts of a house you made for Section A, Unit I, "Introduction to Residential Construction"

SUGGESTED ACTIVITIES

3. Color-coded model of a box cornice
4. Illustrations of finished cornices
5. Blueprints of each type of cornice design
6. Building codes that are related to cornices and gable ends
7. Samples of cornice molding
8. Lumber and saw to illustrate rafter cuts
9. Samples of materials used for soffits
10. Literature from manufacturers of preformed soffit panels
11. Samples of hardware and fasteners used on or with cornices
12. Samples of exterior wall coverings used on gable ends
13. Literature from manufacturers of wall coverings used on gable ends
14. House plans for estimating materials needed for cornices and gable ends
15. Transparencies and competency profiles

    (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

C. Introduce unit.

SUGGESTIONS:

- Provide students with illustrations of various types of finished cornices and gable ends.
- Discuss why cornice and gable-end work fits in at this point of construction.
- Explain why cornices are boxed in.

D. Provide students with objective sheet; discuss unit and specific objectives.

E. Provide students with information, assignment, and job sheets.

SUGGESTED ACTIVITIES

F. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Section I to discuss terms associated with cornices and gable ends.

   SUGGESTIONS:

   - Use the poster you made for the parts of a house to relate cornices and gable ends to other parts of a house.
   - Use a color-coded model of a box cornice to emphasize the function of each part in your discussion of terms.

2. Use Information Sheet, Section II to discuss types of cornice designs.

   SUGGESTIONS:

   - Use illustrations of finished cornices to discuss various cornice designs.
   - Provide the class with blueprints requiring each type of cornice design.
   - Ask students to discuss houses they have seen in your area that use various types of cornice design.

3. Use Information Sheet, Section III to discuss parts of a box cornice.

   SUGGESTIONS:

   - Use Transparency #1 to illustrate the parts of the box cornice.
   - Allow students to disassemble and reassemble the color-coded model cornice.
   - Emphasize considerations in the construction process, such as the variations in the sequence of steps for different exterior finishes.
   - Discuss materials and nailing patterns.
   - Discuss local building codes that are related to box cornices.

4. Use Information Sheet, Section IV to discuss parts of a boxed rake section.

   SUGGESTION:

   - Use Transparency #2 to relate the discussion to the topics covered in the previous discussion.

SUGGESTED ACTIVITIES

5. Use Information Sheet, Section V to discuss types of cornice molding.

   SUGGESTIONS:

   - Use Transparencies #3 and #4 or provide the class with samples of each type of cornice molding illustrated in this section of the information sheet.
   - Explain why one type of molding might be preferable to the others in specific applications.
   - Tour sites where various types of molding are in use.

6. Use Information Sheet, Section VI to discuss types of tail-rafter cuts.

   SUGGESTIONS:

   - Use Transparency #5 to illustrate your discussion of tail-rafter cuts.
   - Demonstrate how each cut is made and allow students to practice making each of these cuts.
   - Discuss how the types of tail-rafter cuts affect possible cornice designs.
   - Discuss the use of blocking and false fascia for each type of cut.

7. Use Information Sheet, Section VII to discuss materials used for soffits.

   SUGGESTIONS:

   - Show the class samples of each type of material discussed in this section of the information sheet.
   - Show the class literature from manufacturers of preformed soffit panels, or ask representatives from the manufacturers or their distributors to talk to the class about their products.

3. Use Information Sheet, Section VIII to discuss types of hardware and fasteners used on or with cornices.

   SUGGESTION:

   - Show the class samples of each type of hardware and fastener discussed in this section of the information sheet, and demonstrate the use of each.

SUGGESTED ACTIVITIES

9. Use Information Sheet, Section IX to discuss exterior wall coverings used on gable ends.

   SUGGESTIONS:

   - Show students samples of each type of wall covering used on gable ends.
   - Discuss how the use of different materials affects the sequence of cornice construction.
   - Show the class literature from manufacturers of wall coverings used on gable ends.

10. Use Information Sheet, Section X to discuss estimating material needed for cornices and gable ends.

    SUGGESTIONS:

    - Demonstrate material estimation, emphasizing the usefulness of information such as that found in Table 1 on this section of the information sheet.
    - Provide students with house plans and have them estimate costs for various types of materials; discuss the cost comparisons in class.
    - Discuss the amount of labor required for various materials.
    - Have students complete Assignment Sheet #1.

11. Review ladder and scaffold safety.

12. Demonstrate the procedures in Job Sheets #1 and #2.

13. Have students complete Job Sheets #1 and #2.

G. Review unit.

H. Give test.

I. Critique test and discuss in class.

J. Reteach if necessary.

K. Complete appropriate sections of competency profiles.

SUGGESTED ACTIVITIES

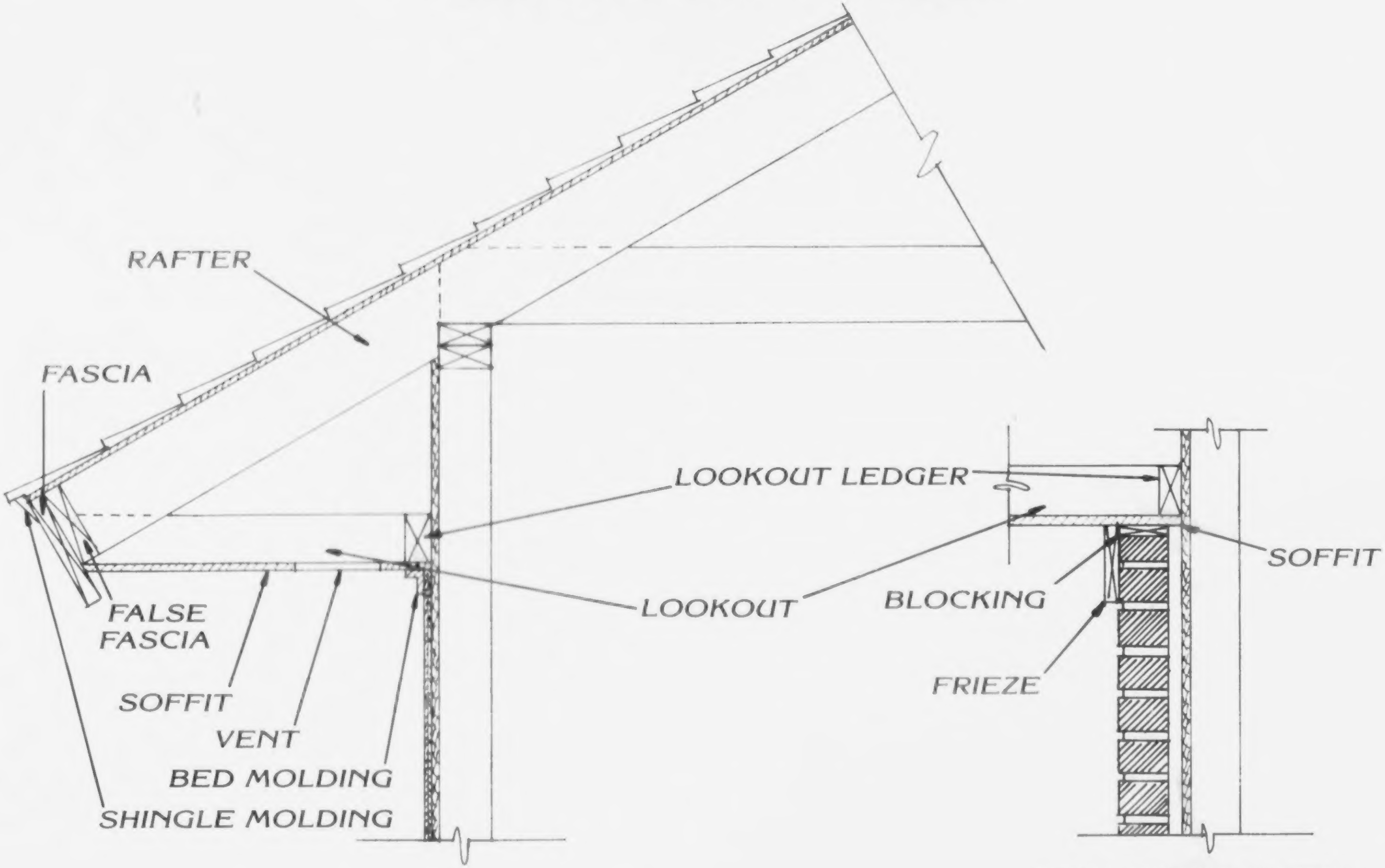
III. Unit references

A. Hendrix, Laborn J. "Bud". *Commercial Carpentry.* Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1979.

B. Hepler, Donald E., and Paul I. Wallach. *Architecture: Drafting and Design,* 3rd ed. New York: McGraw-Hill, 1977.

C. Ramsey, Charles G., and Harold R. Sleeper. *Architectural Graphic Standards,* 6th ed. Edited by Joseph N. Boaz. New York: John Wiley and Sons, Inc., 1970.

Parts of a Box Cornice


RAFTER
FASCIA
LOOKOUT LEDGER
SOFFIT
LOOKOUT
BLOCKING
FALSE FASCIA
SOFFIT
VENT
BED MOLDING
SHINGLE MOLDING
FRIEZE

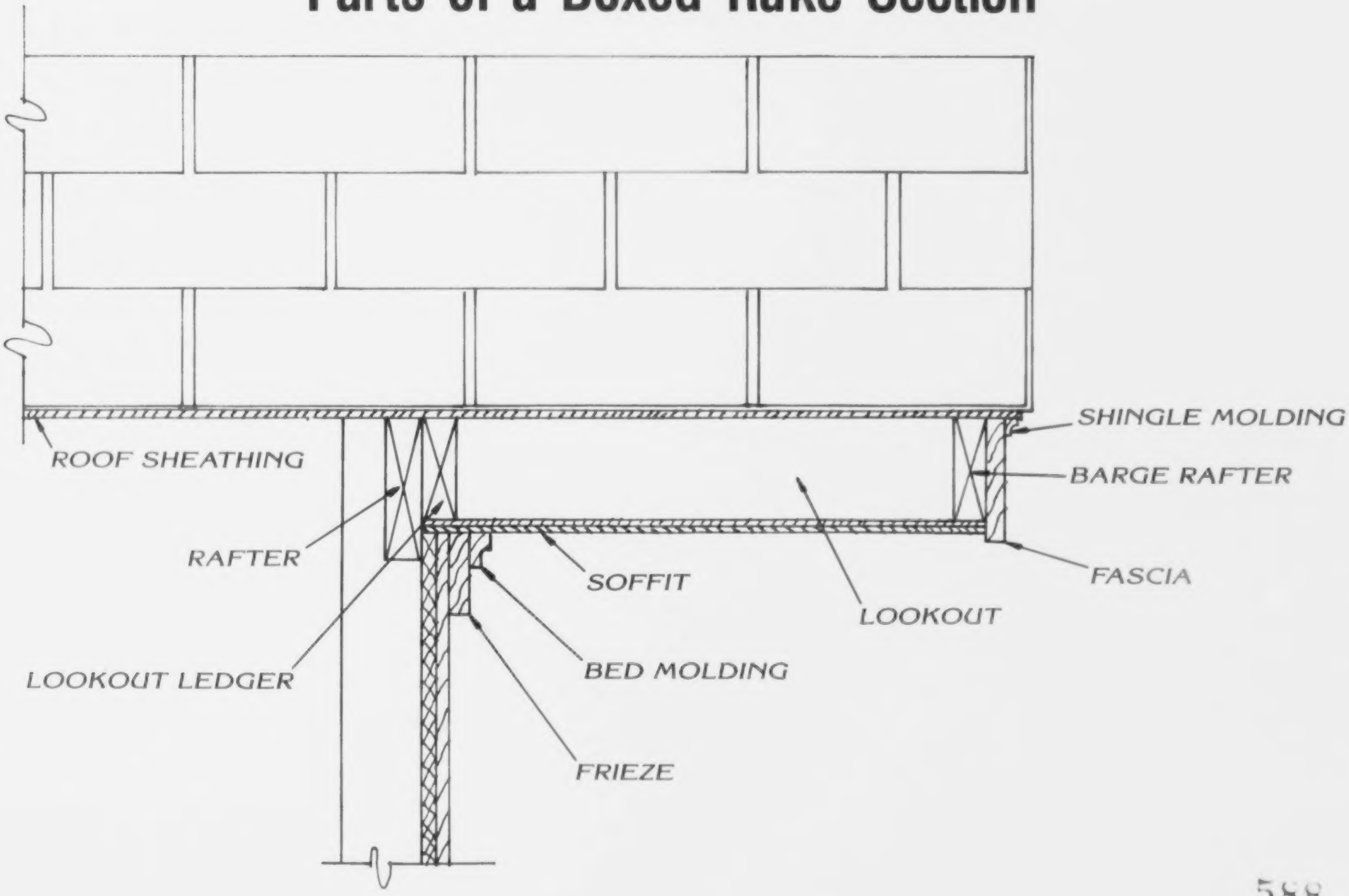
FOR SIDING

FOR RAKE WITH BRICK VENEER

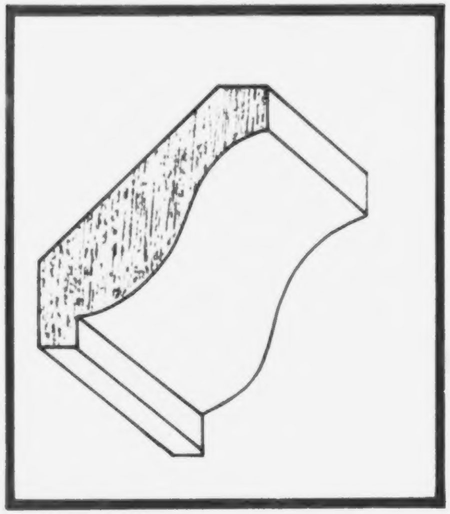
TM #1

RC - 9-E

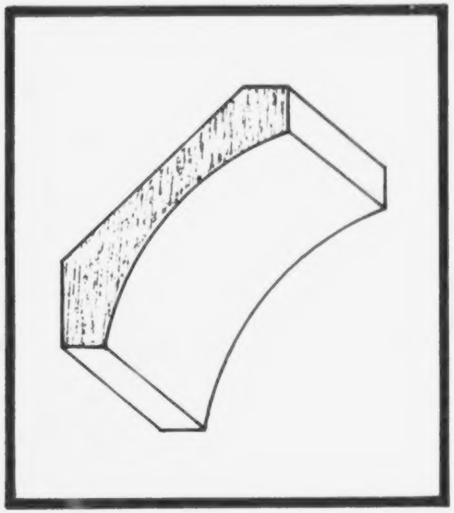
Parts of a Boxed Rake Section


SHINGLE MOLDING
ROOF SHEATHING
BARGE RAFTER
RAFTER
SOFFIT
FASCIA
LOOKOUT
BED MOLDING
LOOKOUT LEDGER
FRIEZE

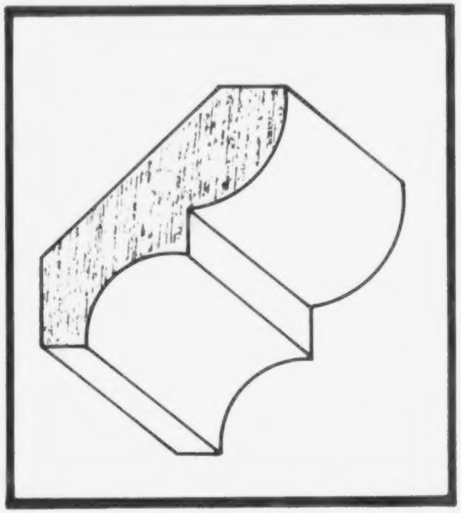
Types of Cornice Molding



CROWN MOLDING



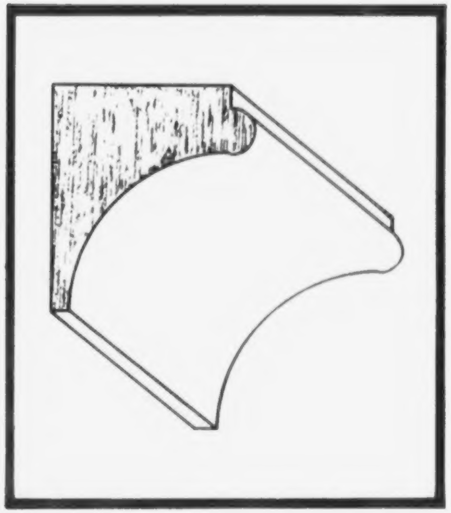
COVE MOLDING



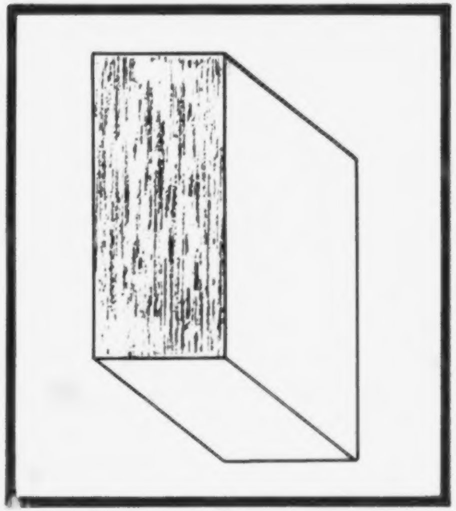
BED MOLDING

Types of Cornice Molding

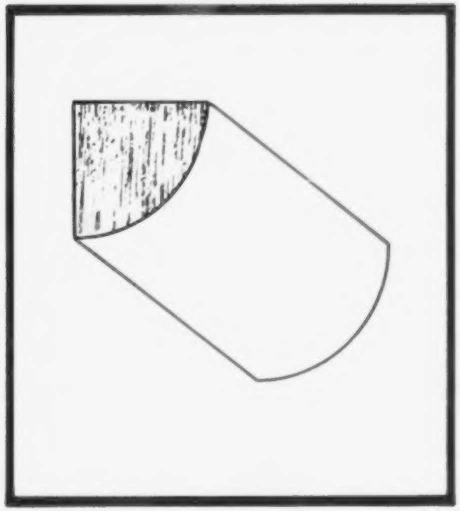
(Continued)



BRICK MOLDING

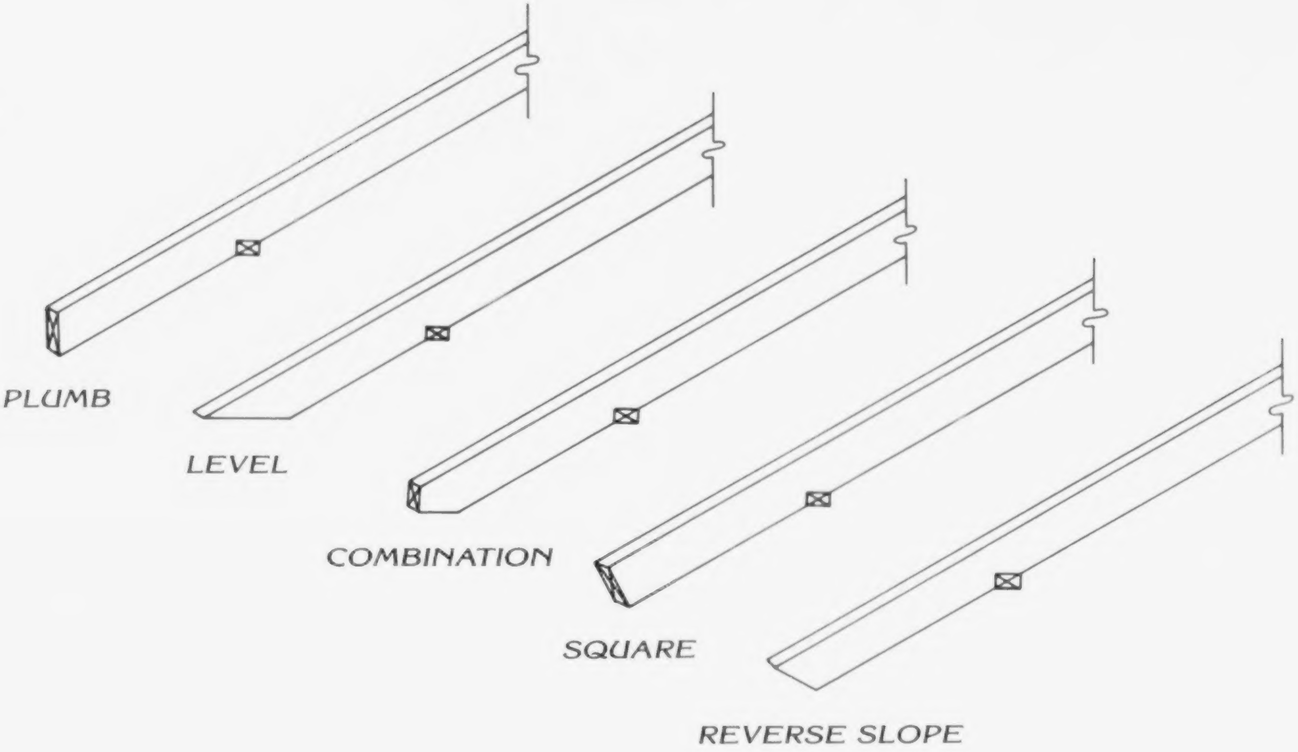


STRIP MOLDING



QUARTER-ROUND MOLDING

Types of Tail-Rafter Cuts


PLUMB
LEVEL
COMBINATION
SQUARE
REVERSE SLOPE

CORNICES AND GABLE ENDS
UNIT I

INFORMATION SHEET

I. Terms and definitions associated with cornices and gable ends

   A. Cornice — Exterior trim that consists of fascia, soffit, and molding and is located where roof and wall meet

   B. Fascia — Outside horizontal member of the cornice that is attached to the ends of the rafters and lookouts

   C. Soffit — Underside of cornice

   D. False fascia (subfascia) — Board that is nailed to the tail of the rafter, straightens and spaces the rafter, and acts as a nailer for the fascia

   E. Lookout — Structural member that is located between the lower end of the rafter and the outside wall; used to attach soffit

   F. Eave (overhang) — Margin or lower part of roof that projects over an exterior wall

   G. Barge rafter — End rafter that is located on the gable end of a roof and becomes part of the overhang

   H. Tail rafter — The part of a rafter that overhangs a wall

   I. Lookout ledger — Wood band that goes around a structure and is level with the false fascia; used to attach lookouts

   J. Frieze — Trim member that is attached to the cornice and is located where the soffit and wall meet

   K. Rake — Trim member that runs parallel to the roof slope on a gable end

   L. Bed molding — Molding that is applied where two surfaces join at an angle; commonly used in cornice trim between soffit and frieze

   M. Batten — Narrow strip of wood that is placed on a surface to cover a joint

   N. Flush — Even with; having or forming a continuous plane or unbroken surface

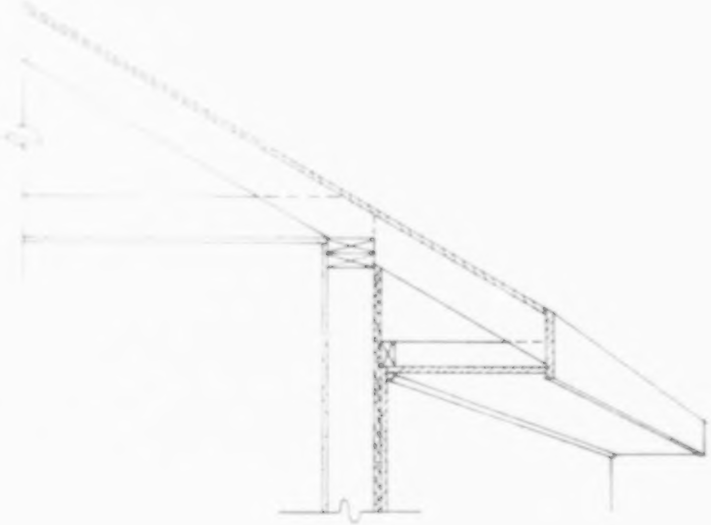
   O. Toenail — To fasten two pieces of wood by driving a nail at an angle

INFORMATION SHEET

II. Types of cornice designs (Figures 1-6)

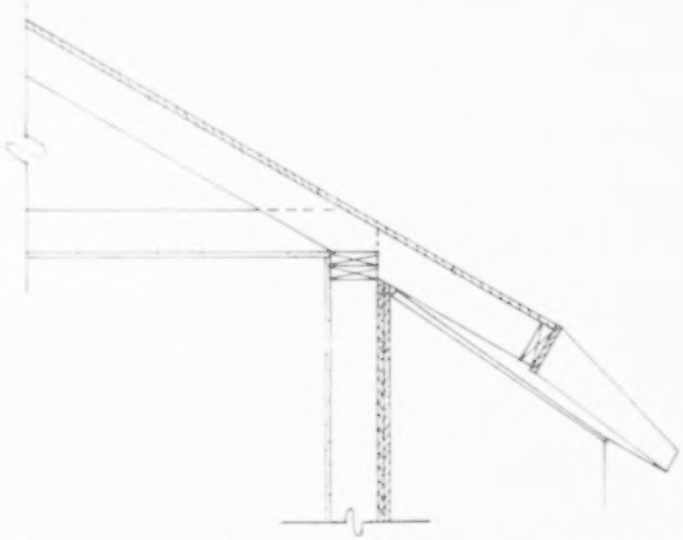
A. Horizontal box cornice

FIGURE 1



B. Sloping box cornice

FIGURE 2

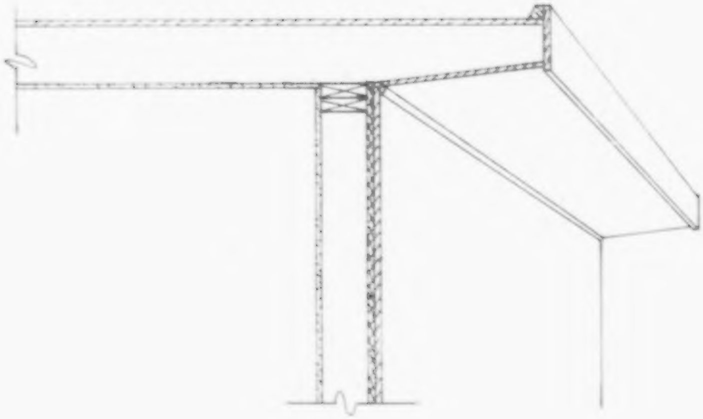


Figures 1 and 2 adapted with permission of the National Forest Products Association, Washington, D.C.

INFORMATION SHEET

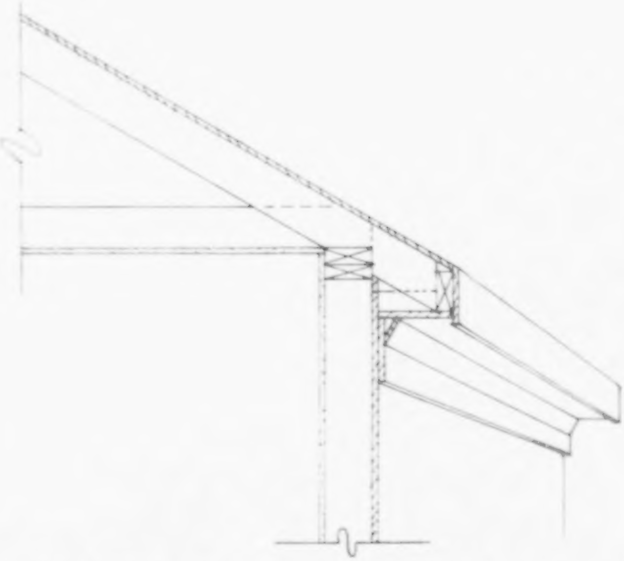
C. Flat-roof overhang with tapered soffit

FIGURE 3



D. Short box cornice

FIGURE 4



Figures 3 and 4 adapted with permission of the National Forest Products Association, Washington, D.C.

INFORMATION SHEET

E. Open cornice

(NOTE: Fascia board may be installed plumb or at a right angle.)

FIGURE 5

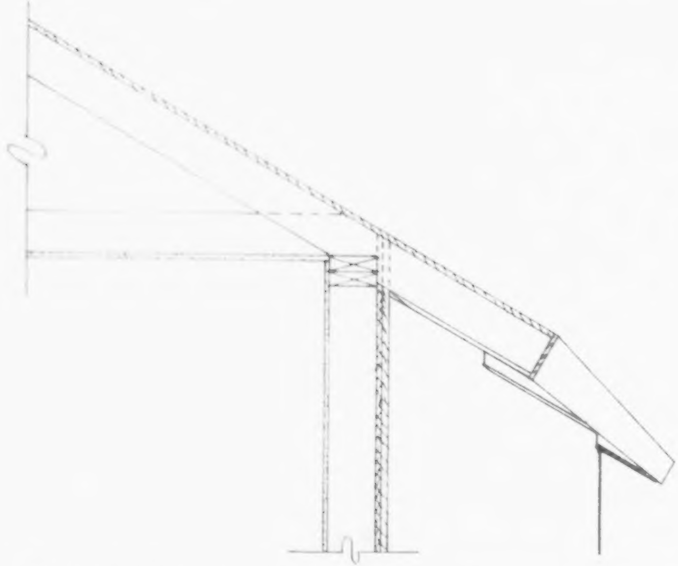
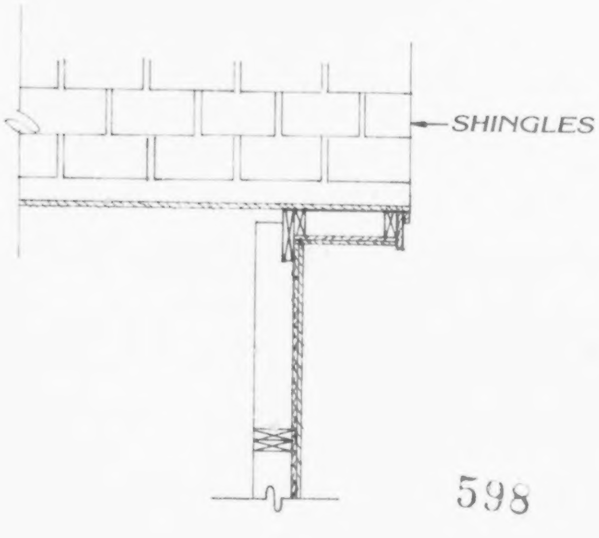


Figure 5 adapted with permission of the National Forest Products Association, Washington, D.C.

F. Boxed rake section

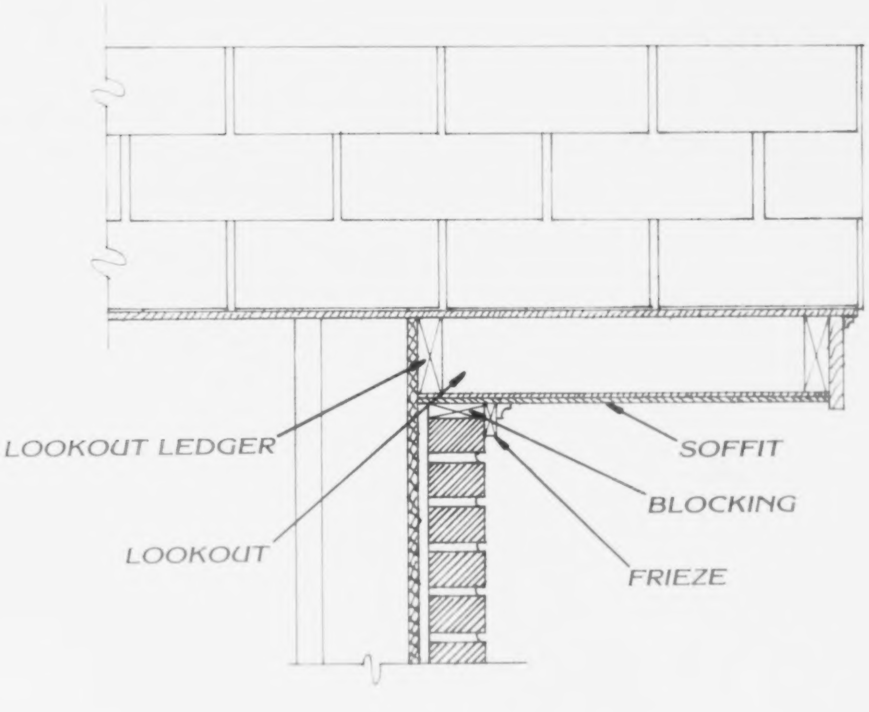
FIGURE 6



INFORMATION SHEET

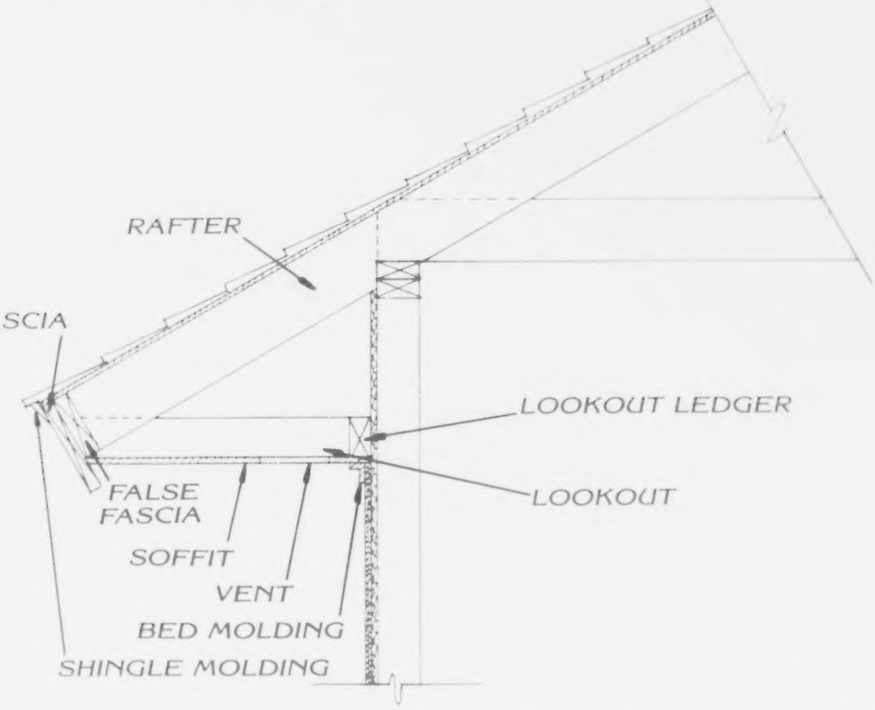
III. Parts of a box cornice (Figures 7 and 8)

FIGURE 7: Box cornice for rake with brick veneer


LOOKOUT LEDGER
LOOKOUT
SOFFIT
BLOCKING
FRIEZE

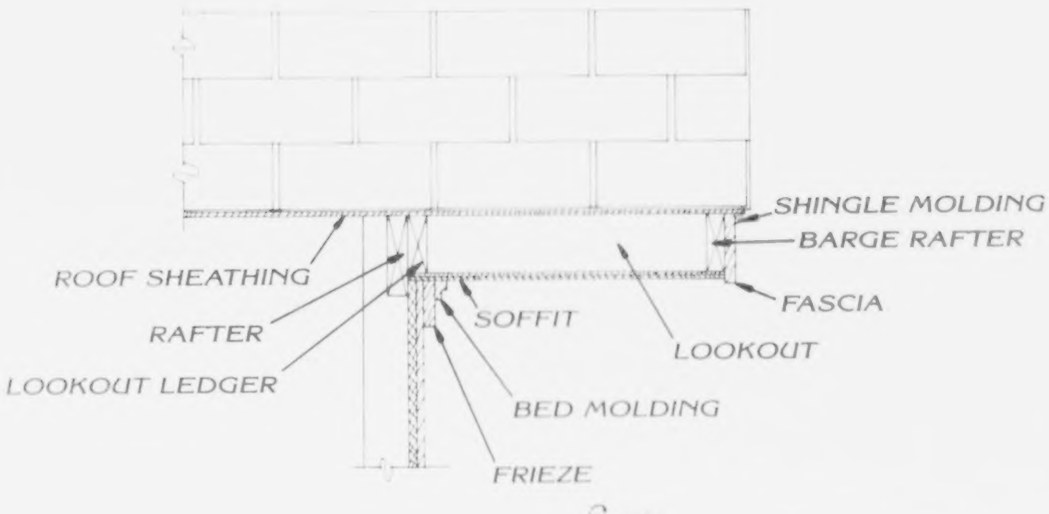
INFORMATION SHEET

FIGURE 8: Box cornice for siding


RAFTER
FASCIA
LOOKOUT LEDGER
LOOKOUT
FALSE FASCIA
SOFFIT
VENT
BED MOLDING
SHINGLE MOLDING

IV. Parts of a boxed rake section (Figure 9)

FIGURE 9

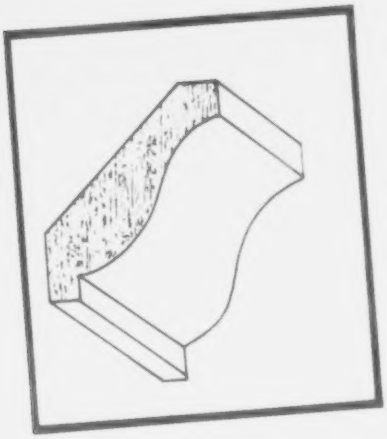

SHINGLE MOLDING
BARGE RAFTER
ROOF SHEATHING
FASCIA
RAFTER
SOFFIT
LOOKOUT
LOOKOUT LEDGER
BED MOLDING
FRIEZE

INFORMATION SHEET

V. Types of cornice molding (Figures 10-15)

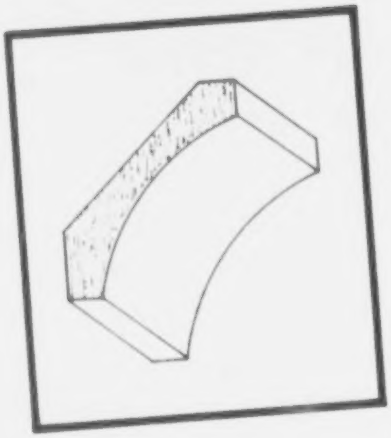
A. Crown molding

FIGURE 10



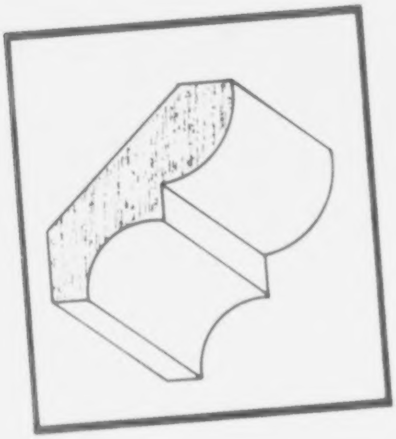
B. Cove molding

FIGURE 11



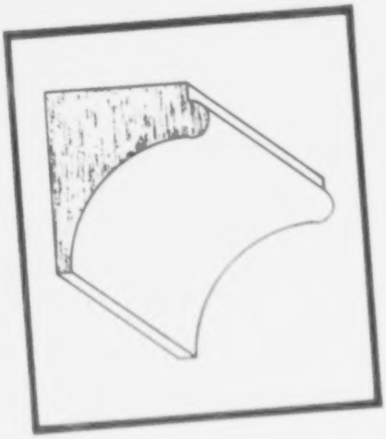
C. Bed molding

FIGURE 12



D. Brick molding

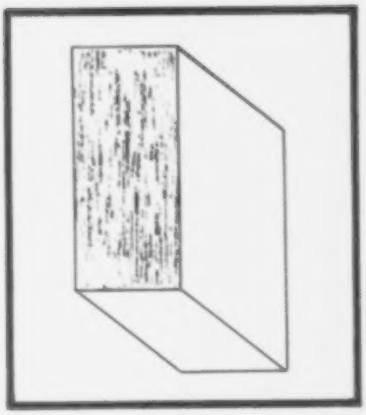
FIGURE 13



INFORMATION SHEET

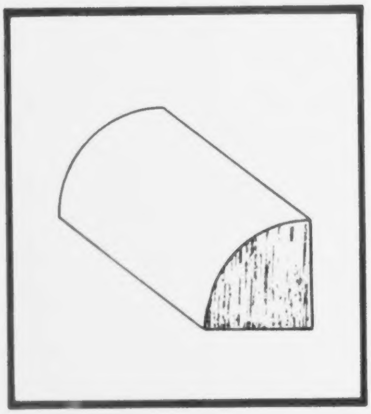
E. Strip molding

FIGURE 14



F. Quarter-round molding

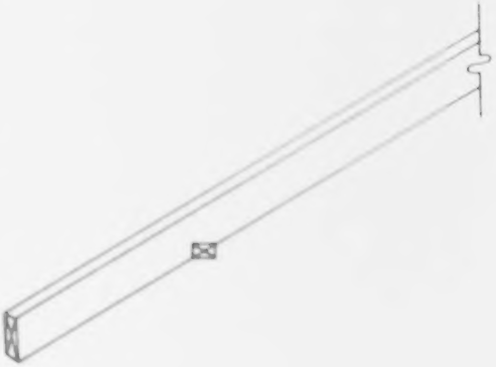
FIGURE 15



VI. Types of tail-rafter cuts (Figures 16-20)

A. Plumb

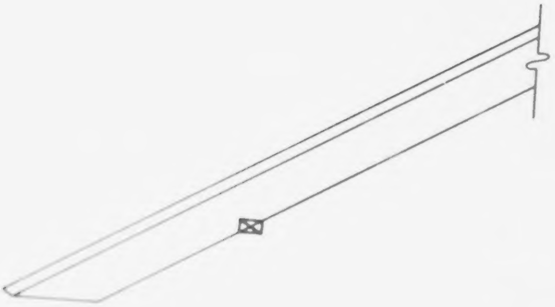
FIGURE 16



INFORMATION SHEET

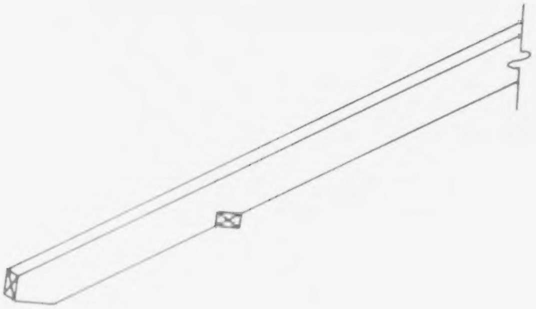
B. Level

FIGURE 17



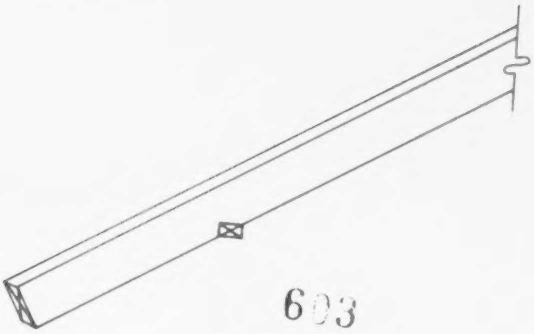
C. Combination

FIGURE 18



D. Square

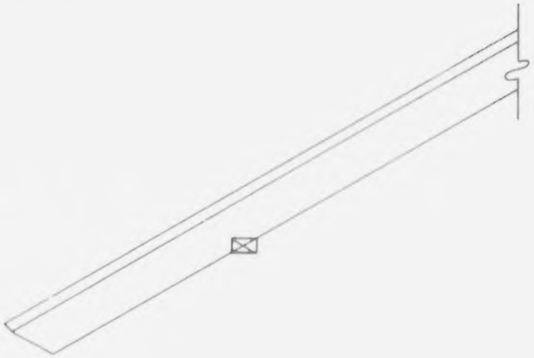
FIGURE 19



INFORMATION SHEET

E. Reverse slope

FIGURE 20



VII. Materials used for soffits

A. Wood

(NOTE: Both plywood and solid wood boards are used for building soffits; however, plywood is probably the most commonly used soffit material.)

B. Fiberboard

C. Laminated wood-fiber material

D. Metal

E. Vinyl

(NOTE: Metal, vinyl, and laminated wood-fiber materials are available in panels of various standard widths and lengths. Some are manufactured with screened vents and some are prefinished.)

VIII. Hardware and fasteners used on or with cornices

A. Galvanized box nails, 4d and 6d

B. Galvanized casing nails, 4d, 6d, and 8d

C. Steel box nails, 8d and 16d

D. Vents

(NOTE: Several varieties of vents are available.)

INFORMATION SHEET

E. Special steel supports

(NOTE: These special supports are made of steel channels with prongs that attach to the soffit.)

F. "H" molding clips

(NOTE: "H" molding clips are used to join the ends of adjacent panels.)

IX. Exterior wall coverings used on gable ends

(NOTE: The materials listed may also be used to finish exterior walls other than gable ends.)

A. Horizontal siding

(NOTE: Gable ends are usually finished with siding applied horizontally; however, gable ends may also be finished with siding set at an angle or in other patterns.)

EXAMPLES: Wood, composition board, metal, vinyl

B. Shingles

(NOTE: Some shingles are manufactured with an insulated backing.)

EXAMPLES: Composition, wood, mineral fiber

C. Panels

EXAMPLES: Plywood, composition board, shingles bonded to a backing

D. Boards and battens

EXAMPLES: Panels and battens, boards and ripped lumber

E. Masonry

EXAMPLES: Brick, stone, stucco, precast masonry

X. Estimating material needed for cornices and gable ends

A. Material needed for gable or hip roof

1. Check specificiations and determine type of wall covering to be used
2. Check specificiations and determine style of cornice to be used
3. Determine running feet of fascia needed for eave and for barge rafter for a gable roof or around the perimeter for a hip roof

   (NOTE: The fascia must be wide enough to project at least ½ inch below the soffit.)
4. Determine the running feet of lumber needed for the lookout ledger
5. Check specifications and determine the length and number of lookouts needed for spacing

INFORMATION SHEET

6. Determine amount of material needed for soffit
7. Determine running feet of frieze board needed

   (NOTE: Cover all areas where the soffit meets the structure's vertical wall covering.)

B. Siding

1. Check specifications and determine type of siding to be used
2. Determine wall area to be covered

   (NOTE: When estimating the amount of siding you will need, remember that siding is generally purchased by the square foot and that door and window openings are disregarded.)

3. Add the necessary percentage for overlap and waste (Table 1)

TABLE 1: Percentages for Overlap and Waste on Siding

Siding	Nominal Width (Inches)	Percentage Added to Wall Area
Bevel	6	40
	8	25
	10	20
	12	15
Tongue and groove	6	20
	8	15
	10	10

CORNICES AND GABLE ENDS
UNIT I

ASSIGNMENT SHEET #1 — ESTIMATE MATERIAL NEEDED FOR CORNICES AND GABLE ENDS

NAME ______________________________ SCORE ______________

Because of the various ways in which cornices and gable ends can be constructed and because of the variety of materials used in their construction, determining material requirements can be a complicated task. To accurately estimate materials, the carpenter must carefully study plans and specifications.

Review Information Sheet, Section X, and estimate the materials specified for the structure illustrated on the next page. Write your answers in the blanks below.

A. 2×4s for lookout ledgers

_____________running feet

B. 2×4s for lookouts

_____________running feet

C. 1×8 fascia

_____________running feet

D. 2×6 false fascia

_____________running feet

E. 2×6 barge rafter

_____________running feet

F. 4′ × 8′ x3/8″ exterior fir plywood for soffit

_____________sheets

G. 4′ × 8′ x1/2″ exterior cedar plywood siding for gable ends

_____________sheets

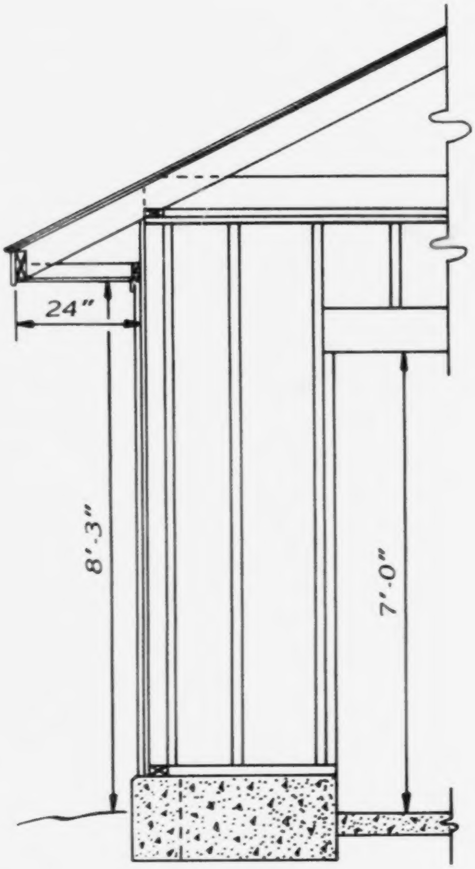
H. Bed molding

_____________running feet

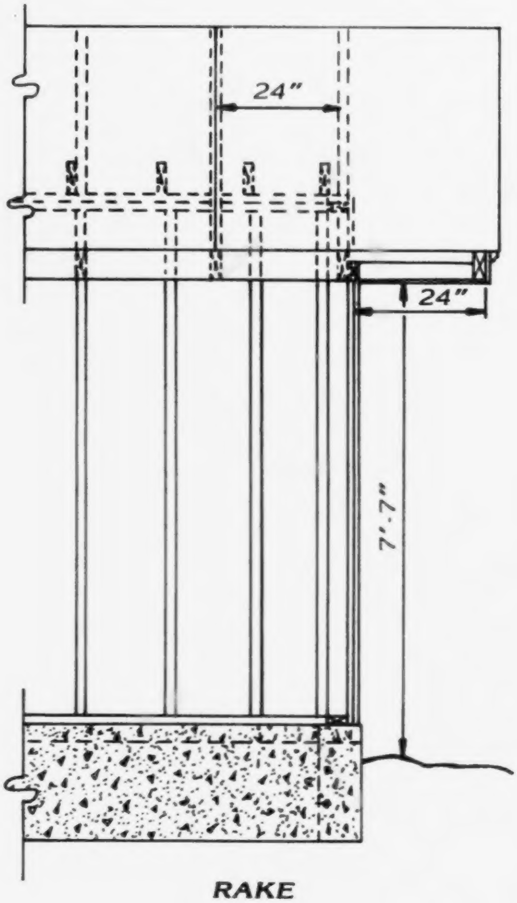
I. Trim molding for gables only

_____________running feet

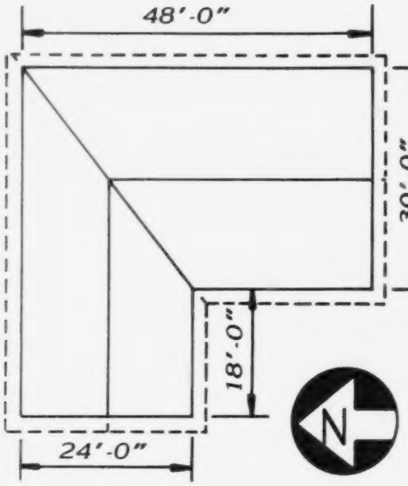
ASSIGNMENT SHEET #1



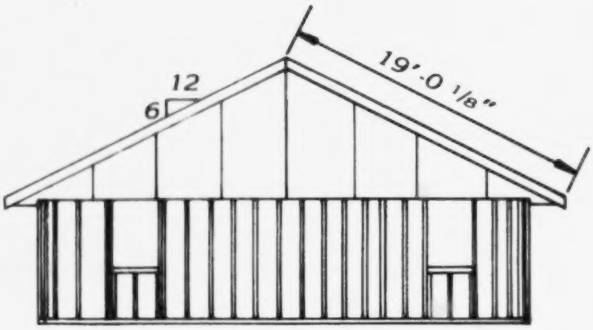
CORNICE



RAKE


48'-0"
30'-0"
18'-0"
24'-0"
N

LOOKOUT SPACING IS SAME AS RAFTER SPACING.



CORNICES AND GABLE ENDS
UNIT I

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

A. 202 running feet
B. 198 running feet
C. 218 running feet
D. 218 running feet
E. 72 running feet
F. 14 sheets
G. 9 sheets
H. 102 running feet
I. 72 running feet

CORNICES AND GABLES ENDS
UNIT I

JOB SHEET #1 — BUILD A HORIZONTAL BOX CORNICE

I. Tools and materials

   A. Tools

      1. Radial arm saw or table saw
      2. Framing square
      3. Folding rule or steel tape
      4. Claw hammer
      5. 4-foot level
      6. Handsaw
      7. Chalk line
      8. Pencil

   B. Materials

      1. 2 × 4s for lookouts
      2. 2 × 4s for lookout ledger
      3. Plywood for soffit
      4. 2 × 6s for false fascia
      5. 1 × 8s for fascia
      6. 1 × 2s for frieze
      7. Galvanized 4d box nails for soffit
      8. Galvanized 8d casing nails for fascia
      9. 8d box nails for lookout ledger
      10. 16d box nails for lookouts

II. Procedure

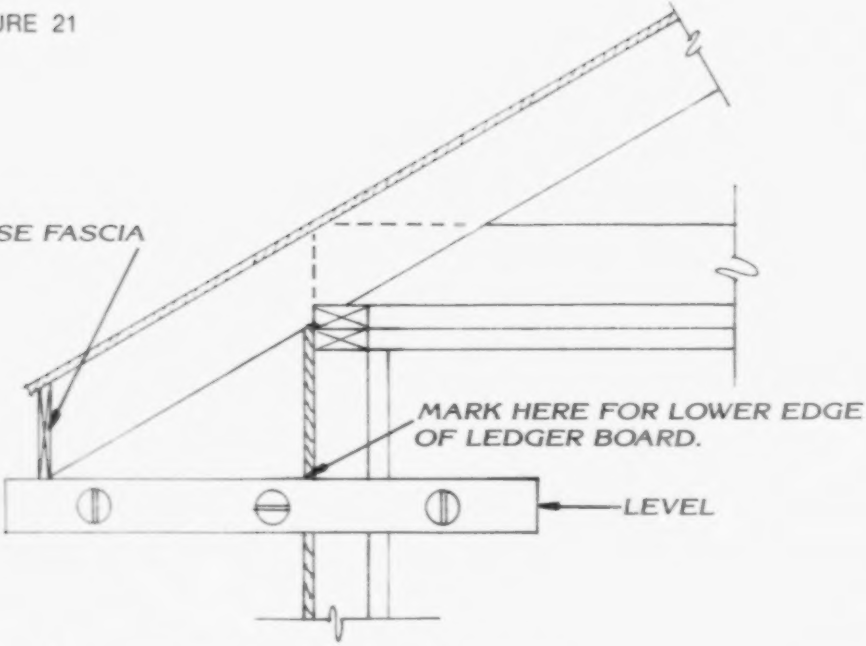
   A. Hip roof

      1. Install lookout ledger

         a. Make a mark on corner of structure where lower edge of lookout ledger will be located at a point level with the bottom of the false fascia (See Figure 21)

JOB SHEET #1

FIGURE 21



b. Repeat Step a at each corner of structure

c. Snap a chalk line on each side of structure between the corner marks

d. Place bottom edge of lookout ledger on chalkline and nail to form a band completely around structure

(NOTE: Nail two 16d box nails at each stud.)

e. Mark a line on the lookout ledger even with one side of each rafter

(NOTE: Always use the same side of each rafter.)

2. Cut and install lookouts

a. To determine correct length for lookouts, measure from inside lower edge of false fascia to outside of lookout ledger

b. Determine number of lookouts that you will need

c. Cut 2 × 4s to determined length

d. Install lookouts

1) Use two 16d box nails to nail outside end of each lookout to the side of each rafter

(NOTE: Be sure to keep outside end of lookout flush with the bottom of the false fascia.)

JOB SHEET #1

   2) Use three 8d box nails to toenail inside end of each lookout to the lookout ledger

      (NOTE: Be sure to keep inside end of the lookout flush with the bottom of the lookout ledger.)

3. Install fascia
   a. Start at one corner of structure and fit fascia
   b. Miter corners and all splices in fascia
   c. Place fascia so that its top edge touches the bottom side of the shingles and its lower edge projects below soffit at least 1/2 inch
   d. Nail fascia in place, using two galvanized 8d casing nails spaced approximately every 16 inches

4. Cut and install soffit
   a. Determine width of soffit

      (NOTE: Most buildings require a 16-inch or 24-inch soffit.)

   b. Rip plywood panels lengthwise into strips of determined width

      (NOTE: If precut panels are used, make sure that soffit material is wide enough and that exposed areas will be covered by trim molding.)

   c. Mark bottom of false fascia at the center of each lookout
   d. Mark sheathing in the middle of each lookout directly under the lookout ledger
   e. Place soffit on marks and nail with 4d galvanized nails, spacing nails approximately every 6 inches

      (NOTE: All splices must be on a lookout, and outside edge of soffit must be flush with outside edge of false fascia.)

5. Install frieze
   a. For wood siding
      1) Install siding before installing frieze

         (NOTE: See Job Sheet #2.)

      2) Place frieze in the corner that is formed where the soffit meets the siding
      3) Nail frieze in place, using 8d casing nails
   b. For brick veneer

      (NOTE: The frieze may be made by ripping strips of 1-inch lumber as specified.)

JOB SHEET #1

1) Measure 5 inches out from the sheathing on the soffit plus the thickness of the frieze board, and make a mark at each corner of structure

   (NOTE: This spacing is for common brick. The spacing will vary with brick size.)

2) Snap a chalk line between the marks on the bottom side of the soffit

   (NOTE: This line is the outside of the frieze.)

3) Nail frieze to 1 × 4 blocking, using 8d galvanized casing nails; fasten the bottom to the brick, using masonry fasteners

   (NOTE: To keep from splitting frieze, drill a hole through the frieze at each nail location.)

B. Gable roof

1. Install lookout ledger

   a. Locate lower edge of lookout ledger, following Steps 1a through e for hip roof

   b. Install lookout ledger only on the sides of structure under the eave

      (NOTE: Run lookout ledger past the ends of the building as far as the outer face of the barge rafter.)

   c. Mark lookout ledger on specified centers to come out on the same side of each rafter

2. Cut and install lookouts

   a. To determine the correct length for lookouts, measure from inside lower edge of false fascia to outside of lookout ledger

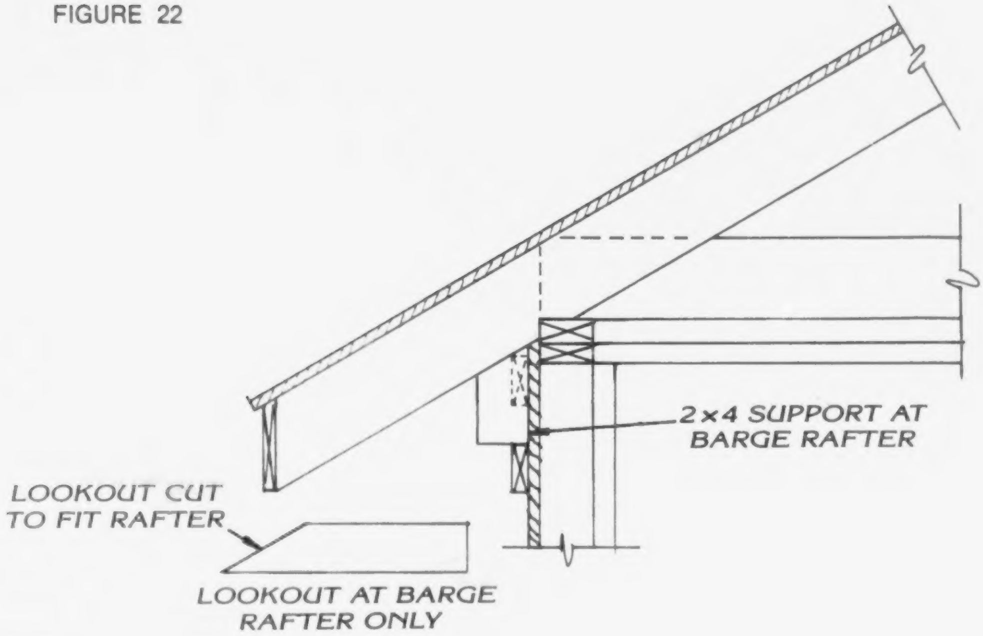
   b. Determine number of lookouts that you will need

   c. Cut 2 × 4s to determined length

   d. Cut four end lookouts to fit bottom of barge rafter (See Figure 22)

JOB SHEET #1

FIGURE 22


2×4 SUPPORT AT
BARGE RAFTER
LOOKOUT CUT
TO FIT RAFTER
LOOKOUT AT BARGE
RAFTER ONLY

   e. Install end lookouts (See Figure 22)

   f. Install remainder of lookouts

      1) Use two 16d box nails to nail outside end of each lookout to the sides of each rafter

         (NOTE: Be sure to keep outside end of lookout flush with the bottom of the flase fascia.)

      2) Use three 8d box nails to toenail inside end of each lookout to lookout ledger

         (NOTE: Be sure to keep inside end of lookout flush with the bottom of the lookout ledger.)

3. Cut and install soffit

   a. Determine width of soffit

   b. Rip plywood panels into strips of determined width

      (NOTE: The soffit for the rake of the roof may be different than for the eave.)

   c. Mark bottom of false fascia at the center of each lookout

JOB SHEET #1

d. Mark sheathing in the middle of each lookout directly under the lookout ledger

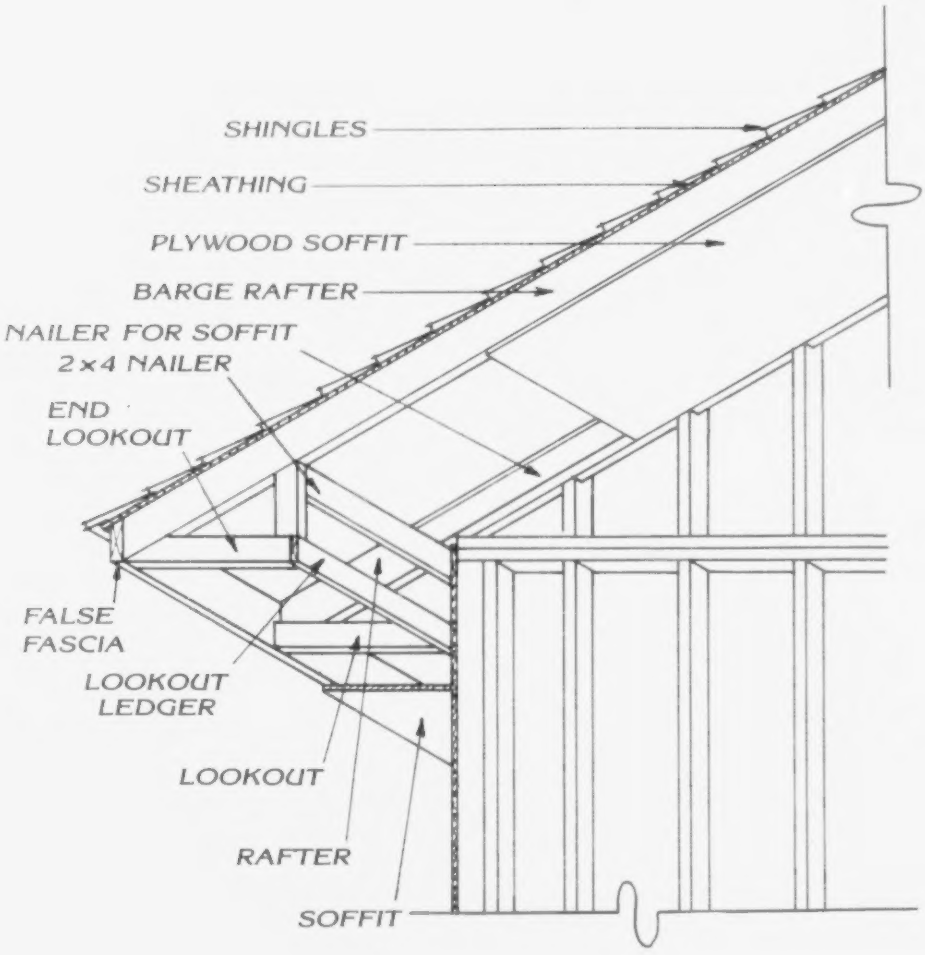
e. Place soffit material on marks and nail in place at gable ends

(NOTE: Start at the peak of the rake and work down both sides. The lower ends need only to extend past the outside of the sheathing.)

f. Nail soffit in place under eaves (Figure 23)

(NOTE: The soffit must be flush with the outside of the false fascia on the sides, flush with the outside face of the barge rafter on the ends, and flush with the outer face of the ledger where it projects past the end of the building.)

FIGURE 23


SHINGLES
SHEATHING
PLYWOOD SOFFIT
BARGE RAFTER
NAILER FOR SOFFIT
2×4 NAILER
END LOOKOUT
FALSE FASCIA
LOOKOUT LEDGER
LOOKOUT
RAFTER
SOFFIT

JOB SHEET #1

4. Install fascia

   a. Start at one corner of structure and fit fascia

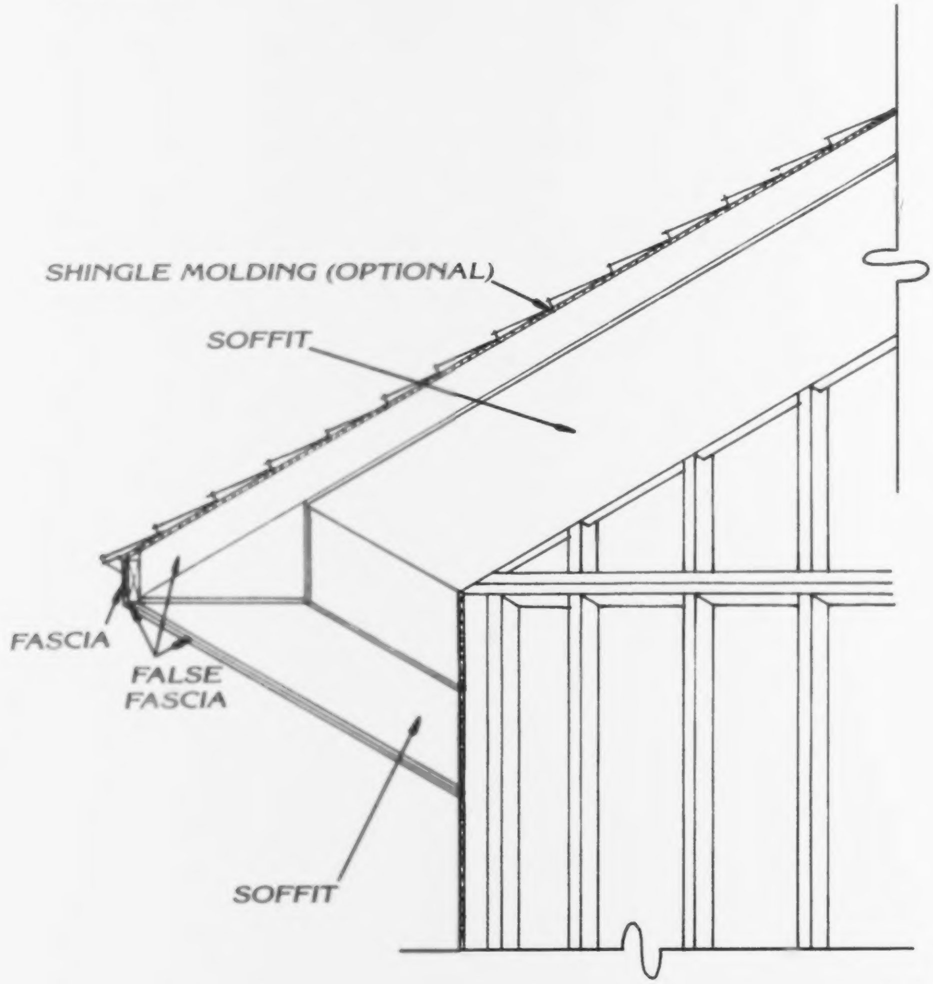
   b. Miter corners and all splices in fascia

   c. Place fascia so that its top edge touches the bottom side of the shingles and its lower edge projects below the soffit at least 1/2 inch

   (NOTE: A shingle mold may be placed at the top of the fascia if desired.)

   d. Nail fascia in place using two galvanized 8d casing nails spaced approximately every 16 inches (Figure 24)

FIGURE 24


SHINGLE MOLDING (OPTIONAL)
SOFFIT
FASCIA
FALSE FASCIA
SOFFIT

JOB SHEET #1

5. Install frieze
   a. For wood siding
      1) Install siding before installing frieze

         (NOTE: See Job Sheet #2.)
      2) Place frieze in the corner that is formed where the soffit meets the siding
      3) Nail frieze in place, using 8d casing nails
   b. For brick veneer

      (NOTE: The frieze may be made by ripping strips from 1-inch lumber as specified.)
      1) Measure 5 inches out from sheathing on soffit plus the thickness of the frieze board and make a mark at each corner of structure

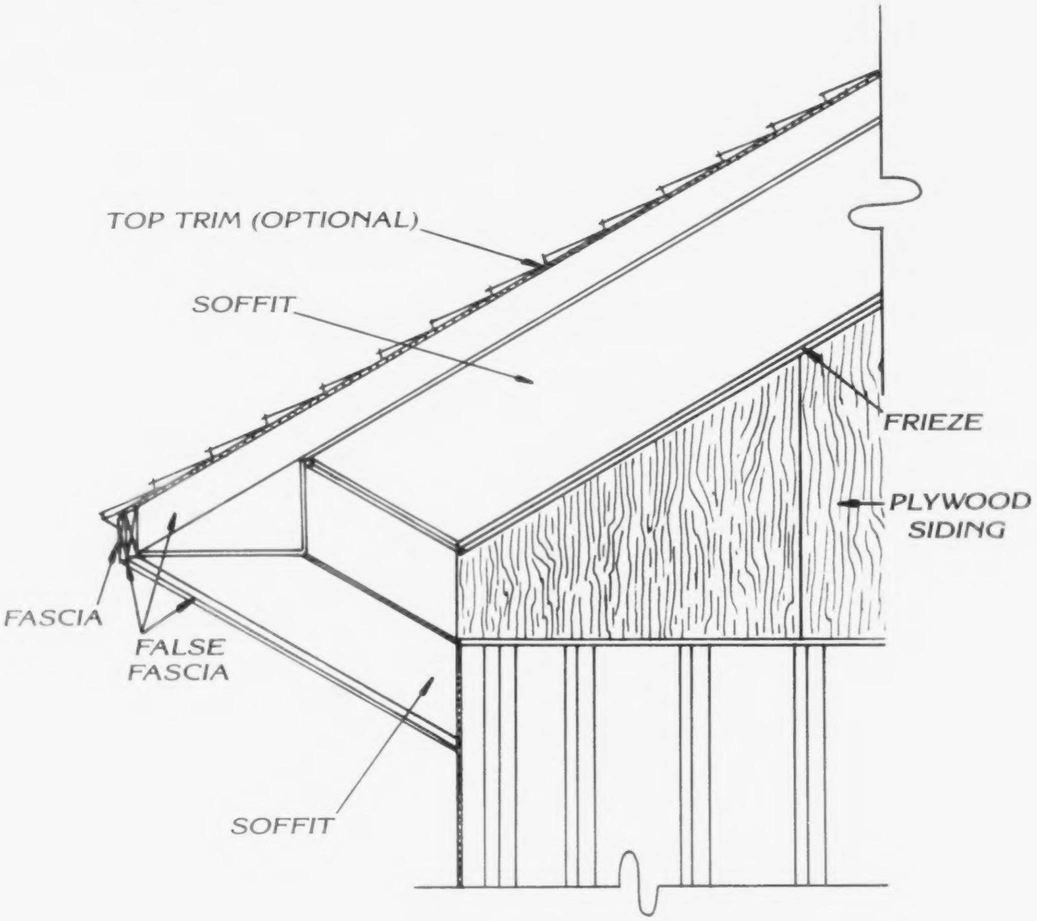
         (NOTE: This spacing is for common brick. The spacing will vary with brick size.)
      2) Snap a chalk line between the marks on the bottom side of the soffit

         (NOTE: This line is the outside of the frieze.)
      3) Nail frieze to 1 × 4 blocking, using 8d galvanized casing nails; fasten the bottom to the brick, using masonry fasteners

         (NOTE: To keep from splitting frieze, drill a hole through the frieze at each nail location. All splices should be on a lookout.)
6. Finish boxing in end of eave (See Figure 25)

JOB SHEET #1

FIGURE 25


TOP TRIM (OPTIONAL)
SOFFIT
FRIEZE
PLYWOOD SIDING
FASCIA
FALSE FASCIA
SOFFIT

C. Clean up area and put away tools and materials

CORNICES AND GABLE ENDS
UNIT I

JOB SHEET #2 — APPLY SIDING TO A GABLE END

I. Tools and materials

A. Framing square

B. Folding rule or steel tape

C. Claw hammer

D. 4-foot level

E. Handsaw

F. Power handsaw and extension cord

G. Chalk line

H. One pair of sawhorses

I. Two 6-foot scaffold sections with adjustable legs

J. 4′ × 8′ ×1/2″ plywood siding

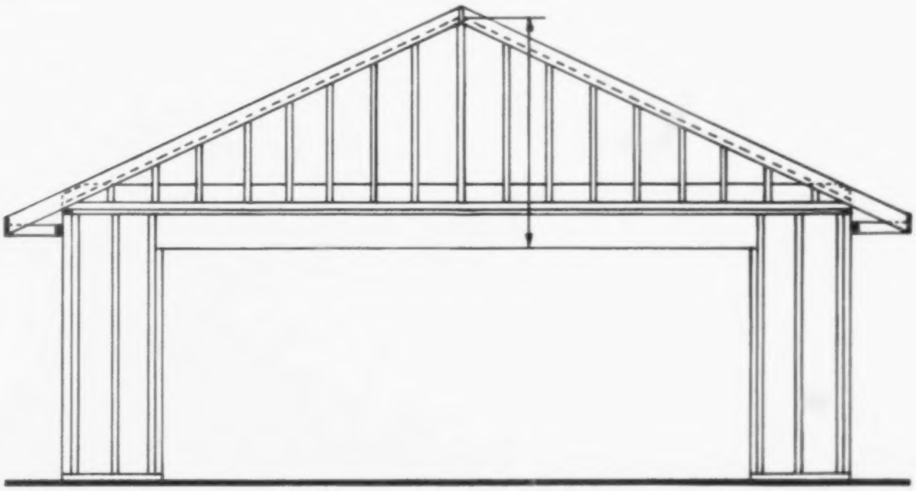
K. Galvanized or aluminum 6d box nails

L. Pencil

II. Procedure

A. Measure from peak of gable to point where the bottom of siding will be to establish length plywood should be at this point (Figure 26)

FIGURE 26



JOB SHEET #2

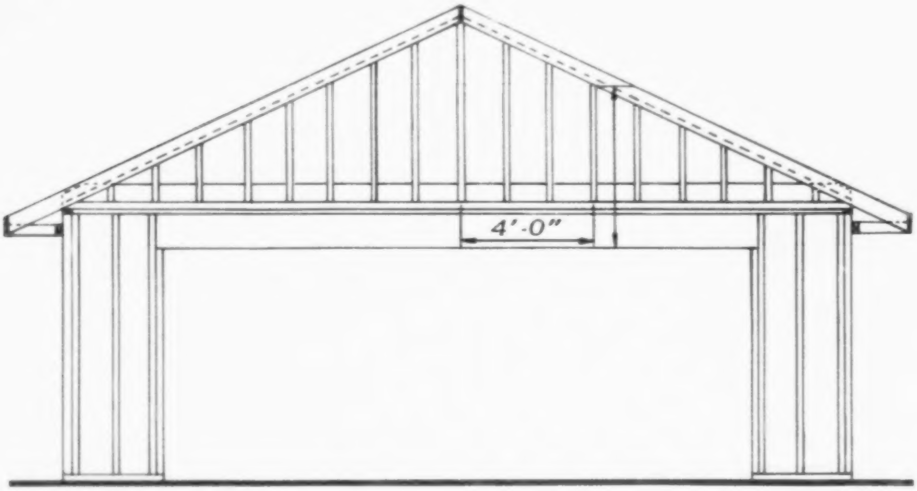
B. Lay plywood face down on sawhorses

C. Transfer gable measurement to plywood by measuring from bottom of right side of plywood up to the distance that you measured on gable

D. From center of gable, measure 4 feet to the right along established bottom of siding (See Figure 27)

E. From 4-foot point at established bottom of siding, measure to top of gable to establish length plywood should be at this point (Figure 27)

FIGURE 27



F. Transfer gable measurement to left side of plywood

G. Using a straightedge or chalk line, mark cutting line on plywood between determined points at top of plywood

(NOTE: This line establishes the angle from which all the siding for this gable should be cut.)

H. Cut plywood along established line

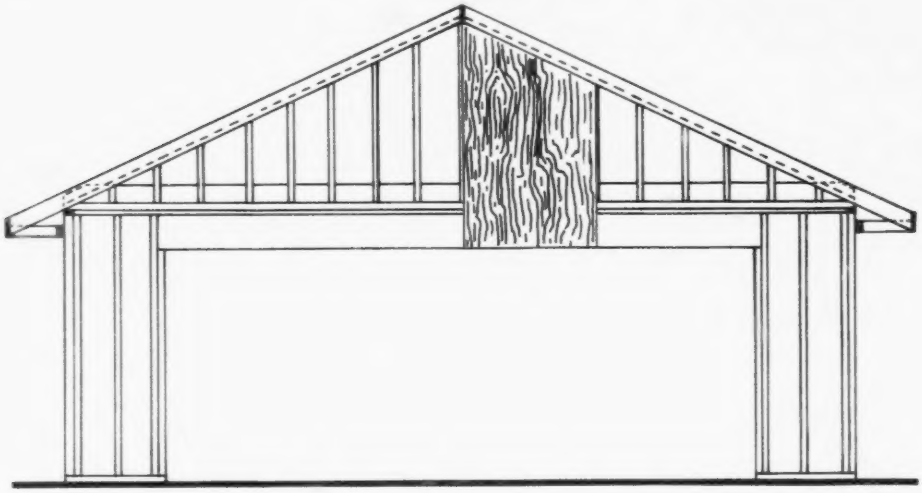
I. Check fit of plywood

JOB SHEET #2

J. Nail plywood in place with galvanized or aluminum nails (See Figure 28)

K. Using level, be sure that edge of plywood is plumb (Figure 28)

FIGURE 28



L. Measure and cut the piece of plywood that will fit to the right of the first piece

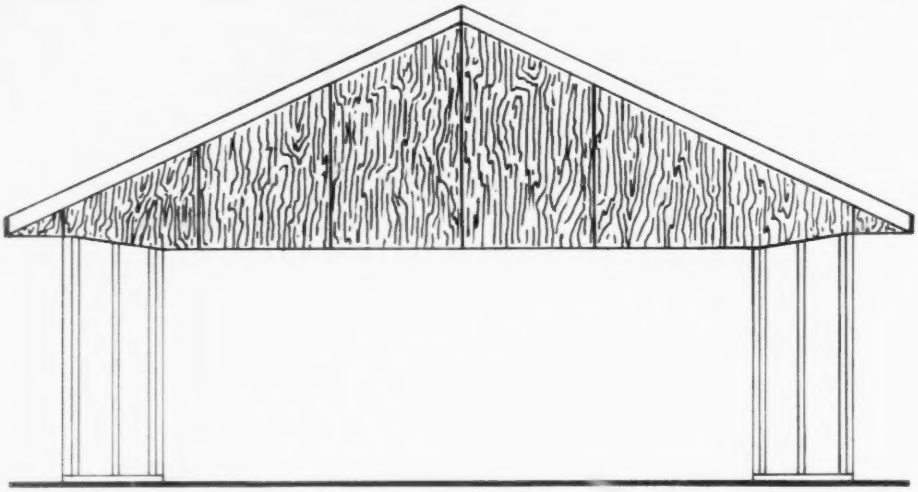
(NOTE: The cut-off piece should be large enough to use for the last piece on right.)

M. Continue the procedure until all of siding on right side of gable has been applied

N. Follow Steps A through M to apply siding to left side of gable (See Figure 29)

JOB SHEET #2

FIGURE 29



O. Clean up area and put away tools and materials

CORNICES AND GABLE ENDS
UNIT I

TEST

NAME ________________________________ SCORE ______________

1. Match to their correct definitions terms associated with cornices and gable ends. Write the correct numbers in the blanks. Definitions continue on the next page.

______a. Molding that is applied where two surfaces join at an angle; commonly used in cornice trim between soffit and frieze

______b. Underside of cornice

______c. Board that is nailed to the tail of the rafter, straightens and spaces the rafter, and acts as a nailer for the fascia

______d. Trim member that runs parallel to the roof slope on a gable end

______e. Narrow strip of wood that is placed on a surface to cover a joint

______f. To fasten two pieces of wood by driving a nail at an angle

______g. Trim member that is attached to the cornice and is located where the soffit and wall meet

______h. End rafter that is located on the gable end of a roof and becomes part of the overhang

______i. Margin or lower part of roof that projects over an exterior wall

______j. Outside horizontal member of the cornice that is attached to the ends of the rafters and lookouts

______k. The part of a rafter that overhangs a wall

______l. Structural member that is located between the lower end of the rafter and the outside wall; used to attach soffit

______m. Exterior trim that consists of fascia, soffit, and molding and is located where roof and wall meet

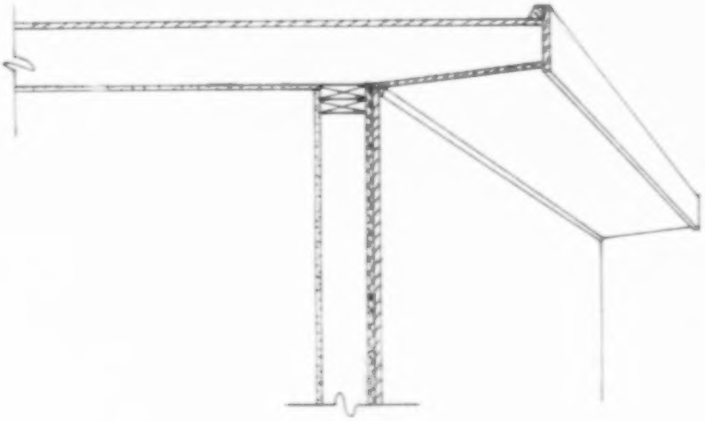
1. Toenail
2. Lookout
3. Flush
4. Bed molding
5. Frieze
6. Tail rafter
7. Batten
8. Barge rafter
9. Soffit
10. Fascia
11. Cornice
12. Rake
13. Eave (overhang)
14. Lookout ledger
15. False fascia (subfascia)

TEST

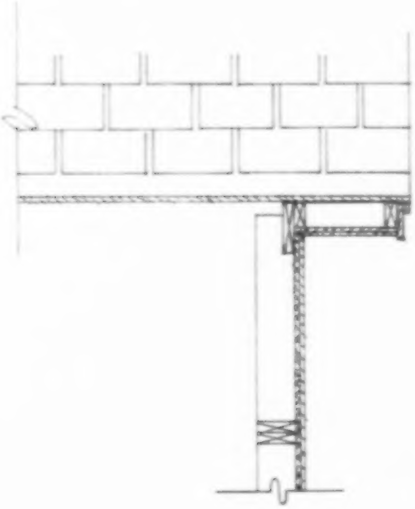
______n. Even with; having or forming a continuous plane or unbroken surface

______o. Wood band that goes around a structure and is level with the false fascia; used to attach lookouts

2. Label the types of cornice designs illustrated below and on the following pages. Write the correct names in the blanks.

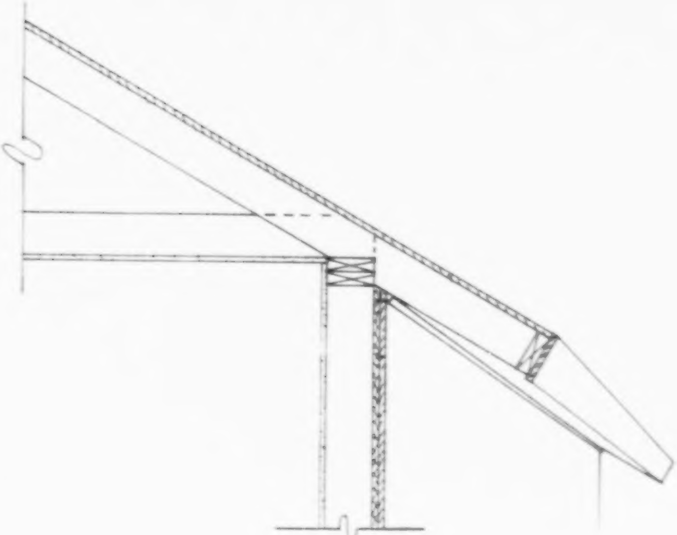


a. ______________________________

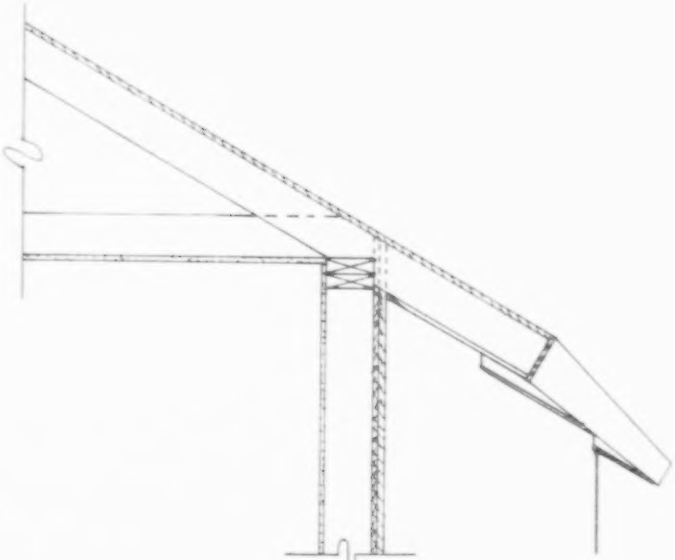


b. ______________________________

TEST

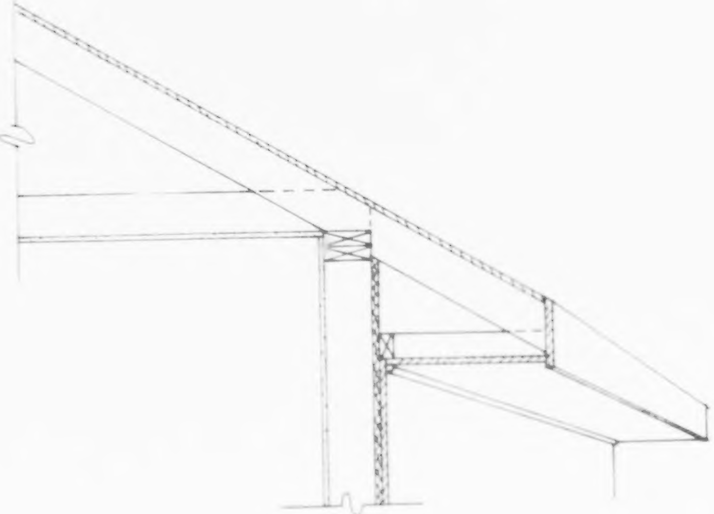


c. ______________________________

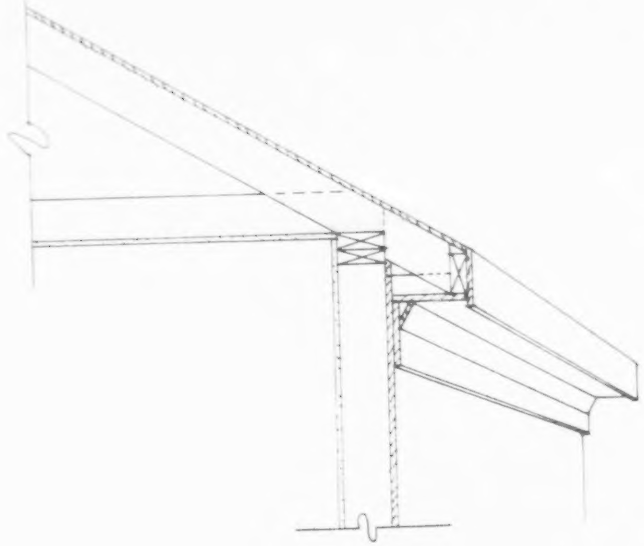


d. ______________________________

TEST



e. ____________________



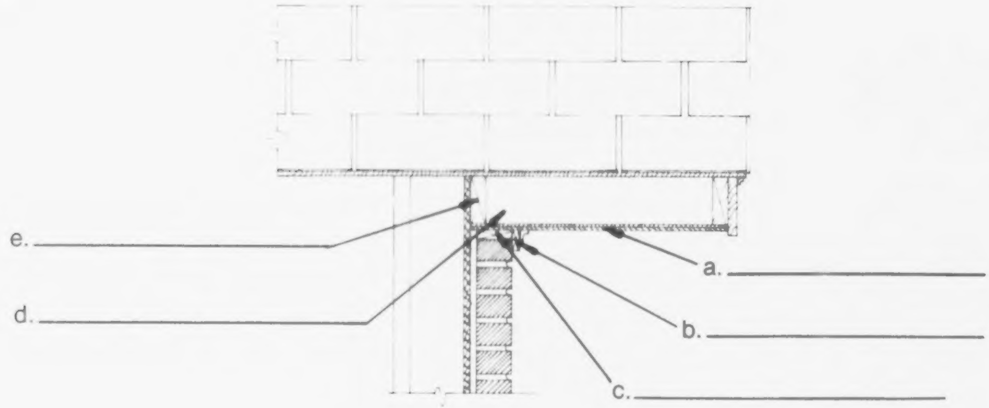
f. ____________________

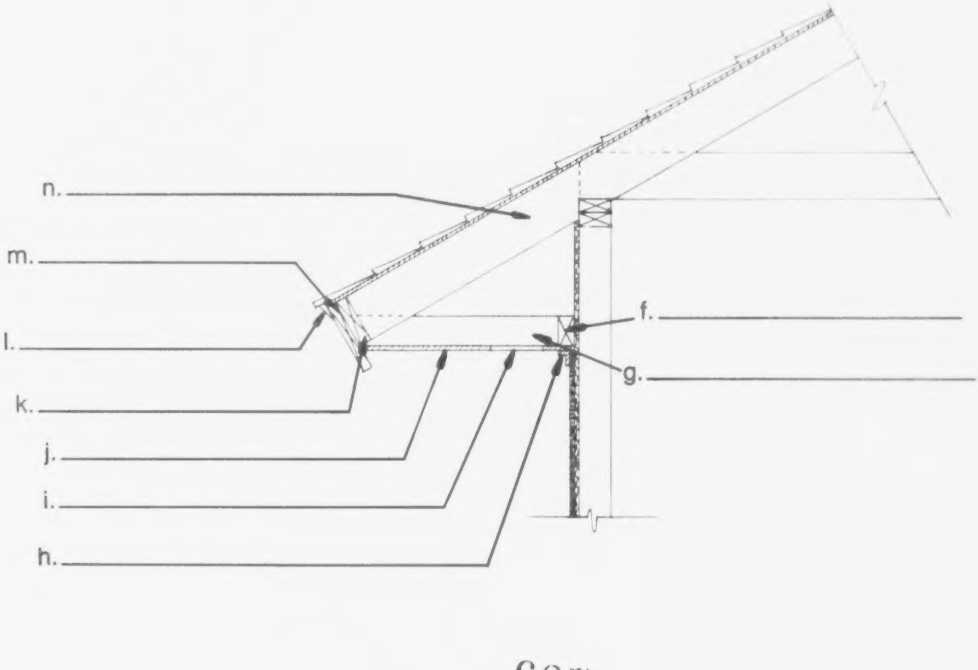
626

TEST

3. Identify the parts of the boxed cornices illustrated below. Write the correct names in the blanks. Some answers will be used more than once.

Lookout ledger
Soffit
Rafter
Fascia
Blocking
Vent
Lookout
Frieze
Shingle molding
False fascia
Bed molding

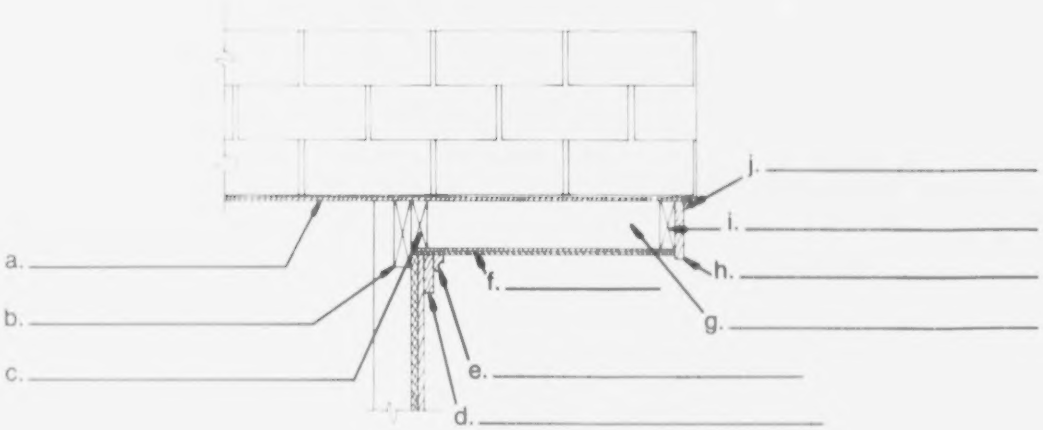




TEST

4. Identify the parts of the boxed rake section illustrated below. Write the correct names in the blanks.

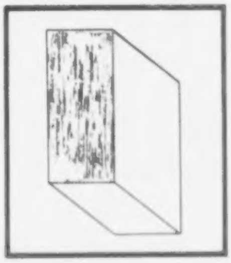
Lookout
Barge rafter
Soffit
Shingle molding
Lookout ledger
Fascia
Bed molding
Frieze
Rafter
Roof sheathing



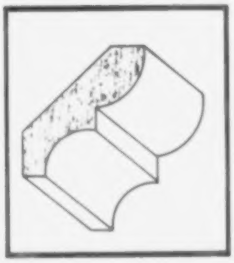
TEST

5. Identify the types of cornice molding illustrated below. Write the correct names in the blanks.

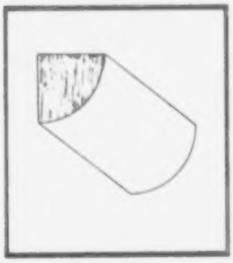
Crown molding	**Cove molding**
Brick molding	**Strip molding**
Bed molding	**Quarter-round molding**



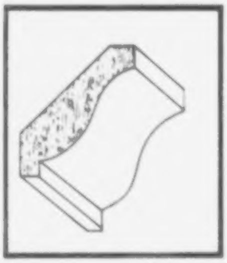
a. ______________________________



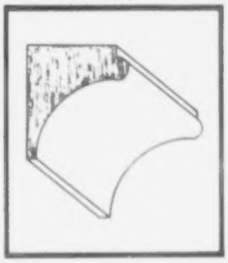
b. ______________________________



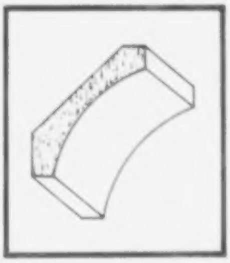
c. ______________________________



d. ______________________________



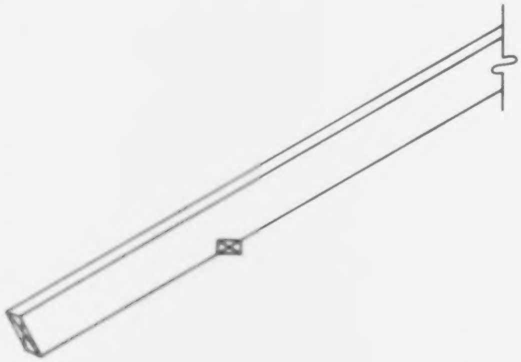
e. ______________________________



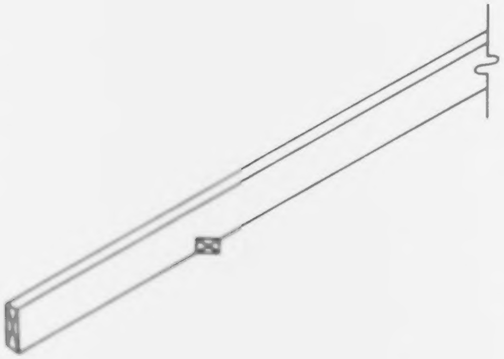
f. ______________________________

TEST

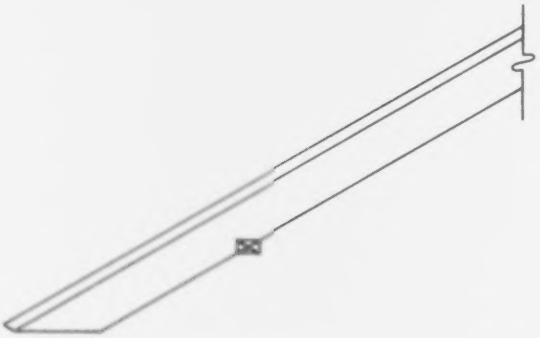
6. Label the types of tail-rafter cuts illustrated below and on the next page. Write the correct names in the blanks.



a. ______________________

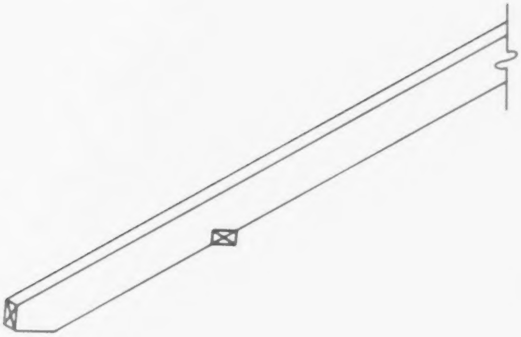


b. ______________________

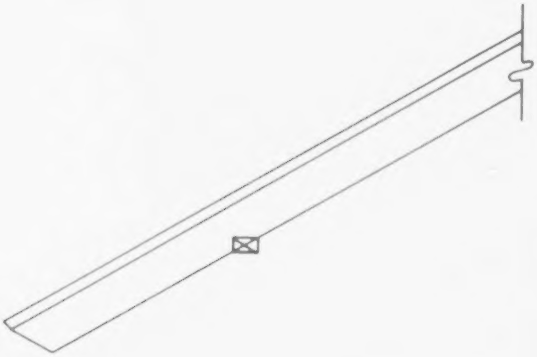


c. ______________________

TEST



d. ______________________________



e. ______________________________

7. Select from the following list materials used for soffits. Write an "X" in the blank before each correct answer.

______a. Laminated wood-fiber material

______b. Wood

______c. Fiberboard

______d. Formica

______e. Metal

______f. Asphalt shingles

______g. Vinyl

TEST

8. Select from the following list hardware and fasteners used on or with cornices. Write an "X" in the blank before each correct answer.

    _____a. "X" molding clips

    _____b. Steel finishing nails, 16d

    _____c. Vents

    _____d. Galvanized box nails, 4d and 6d

    _____e. Special steel supports

    _____f. Metal rafter hangers

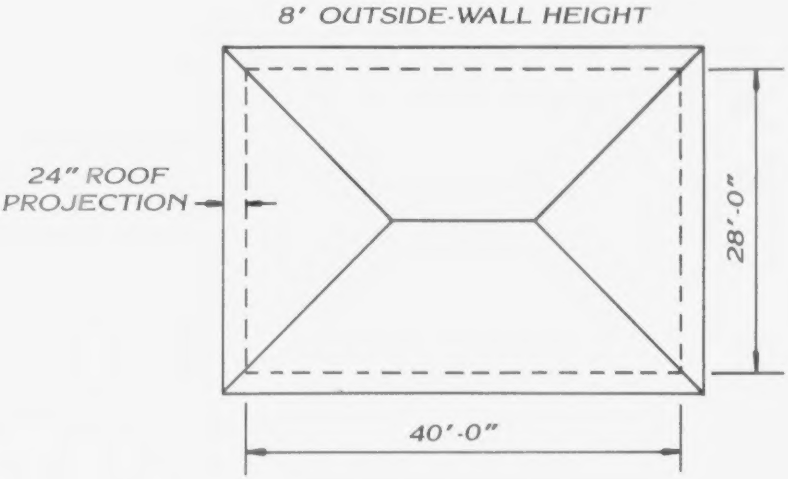
9. Name three exterior wall coverings used on gable ends.

    a. ____________________

    b. ____________________

    c. ____________________

10. Estimate the number of square feet of 1/4-inch plywood that will be needed for the soffit of the structure illustrated below. Show your work.



____________________ square feet

TEST

(NOTE: Test question 11 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

11. Demonstrate the ability to

    a. Build a horizontal box cornice.

    b. Apply siding to a gable end.

CORNICES AND GABLE ENDS
UNIT I

ANSWERS TO TEST

1.
   - a. 4
   - b. 9
   - c. 15
   - d. 12
   - e. 7
   - f. 1
   - g. 5
   - h. 8
   - i. 13
   - j. 10
   - k. 6
   - l. 2
   - m. 11
   - n. 3
   - o. 14

2.
   - a. Flat-roof overhang with tapered soffit
   - b. Boxed rake section
   - c. Sloping box cornice
   - d. Open cornice
   - e. Horizontal box cornice
   - f. Short box cornice

3.
   - a. Soffit
   - b. Frieze
   - c. Blocking
   - d. Lookout
   - e. Lookout ledger
   - f. Lookout ledger
   - g. Lookout
   - h. Bed molding
   - i. Vent
   - j. Soffit
   - k. False fascia
   - l. Shingle molding
   - m. Fascia
   - n. Rafter

4.
   - a. Roof sheathing
   - b. Rafter
   - c. Lookout ledger
   - d. Frieze
   - e. Bed molding
   - f. Soffit
   - g. Lookout
   - h. Fascia
   - i. Barge rafter
   - j. Shingle molding

5.
   - a. Strip molding
   - b. Bed molding
   - c. Quarter-round molding
   - d. Crown molding
   - e. Brick molding
   - f. Cove molding

6.
   - a. Square
   - b. Plumb
   - c. Level
   - d. Combination
   - e. Reverse slope

7. a, b, c, e, g

8. c, d, e

ANSWERS TO TEST

9. Answer should include any three of the following

   a. Horizontal siding
   b. Shingles
   c. Panels
   d. Boards and battens
   e. Masonry

10. 288 square feet

11. Performance skills evaluated to the satisfaction of the instructor

ROOF FINISHES
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to discuss roof construction and apply roofing and flashing. The student will show this knowledge by completing assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with roofing to their correct definitions.
2. State safety rules pertaining to roofing.
3. Identify the parts of a roof.
4. Identify traditional residential roof designs.
5. Name classes of roofing.
6. Match minimum slope requirements to their specific roofing applications.
7. List types of roofing materials.
8. Identify basic types of asphalt shingles.
9. Distinguish between the definitions of wood shingles and wood shakes.
10. State decking requirements for applying wood shingles and wood shakes.
11. State guidelines for applying wood shingles.
12. State guidelines for applying wood shakes.
13. List guidelines for applying underlayment.
14. Describe general requirements for applying flashing.
15. Select from a list areas where flashing should be used.
16. Select from a list types of materials used for flashing.
17. Match roofing equipment and tools to their correct uses.
18. Select from a list guidelines for applying double starter course of asphalt shingles.

OBJECTIVE SHEET

19. State guidelines for applying shingles with cutouts that break joint in half.
20. Arrange in order steps for installing flashing at open-valley locations.
21. Estimate roofing materials needed for a three-tab asphalt-shingle roof.
22. Demonstrate the ability to
    a. Install and then disassemble roof brackets and scaffold plank.
    b. Apply asphalt shingles with 5-inch exposure.
    c. Apply wood shingles with 5-inch exposure over spaced sheathing.

ROOF FINISHES
UNIT II

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Supplements

      1. Supplement #1 — Basic Types of Asphalt Shingles

      2. Supplement #2 — Standards for Wood Shingles

      3. Supplement #3 — Standards for Wood Shakes

      4. Supplement #4 — Roofing Hardware and Fasteners

   D. Transparency masters

      1. TM #1 — Parts of a Roof

      2. TM #2 — Minimum Slope Requirements for Various Roof Applications

      3. TM #3 — Underlayment Installation

      4. TM #4 — Underlayment Installation at Hips and Valleys

      5. TM #5 — Chimney Flashing

      6. TM #6 — Flashing at Wall Intersection

      7. TM #7 — Open-Valley Flashing

      8. TM #8 — Closed-Valley Flashing with Asphalt Shingles

      9. TM #9 — Valley Flashing for Wood Shingles or Shakes

      10. TM #10 — Roofing Fasteners

      11. TM #11 — Roofing Fasteners (Continued)

      12. TM #12 — Roofing Fasteners (Continued)

      13. TM #13 — Asphalt-Shingle Installation Patterns

      14. TM #14 — One-Half Break Asphalt-Shingle Installation Pattern

      15. TM #15 — Installation of Hip and Ridge Shingles

SUGGESTED ACTIVITIES

E. Information sheet

F. Assignment Sheet #1 — Estimate Roofing Materials

G. Answers to assignment sheet

H. Job sheets

   1. Job Sheet #1 — Install and Then Disassemble Roof Brackets and Scaffold Plank

   2. Job Sheet #2 — Apply Saturated-Felt Underlayment and Asphalt Shingles with 5-Inch Exposure

   3. Job Sheet #3 — Apply Wood Shingles with 5-Inch Exposure over Spaced Sheathing

I. Test

J. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

   B. Obtain materials to supplement unit.

      1. Pictures of roof damage resulting from poorly installed roofing materials

      2. Samples of water-damaged lumber and drywall

      3. Transparencies and assignment sheets from *Fundamentals of Carpentry*, "Safety and Basic First Aid"

      4. Ladders to use to demonstrate ladder safety

      5. Safety posters on roofing safety

      6. Roofing brackets and scaffolding plank

      7. Model of a roof, showing the various parts

      8. Specifications for the various types of traditional roof designs

      9. Samples of roofing materials

      10. Sheet of plywood covered with asphalt shingles to demonstrate slope

      11. Samples of the various types of roofing materials

SUGGESTED ACTIVITIES

12. Samples of asphalt shingles and manufacturer's instructions for each type

13. Samples of wood shakes and wood shingles

14. Small model of spaced decking

15. Samples of underlayment

16. Samples of the various materials used for flashing

17. Samples of flashing styles and vent stacks and other roofing products with attached flashing

18. Transparency masters and competency profiles

    (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

C. Introduce unit, emphasizing the importance of properly installed roofing and flashing materials.

SUGGESTIONS:

- Show the class pictures of roof damage resulting from poorly installed roofing materials; explain the type of damage that can result.
- Emphasize the role of roofing in maintenance as well as in new-house construction and remodeling.
- Show the class samples of water-damaged lumber, drywall, or other materials; allow the students to crumble the materials to witness the weakened state of water-damaged material.
- Invite a roofing specialist to talk to the class about why someone would specialize in installing roofing; use a former student if at all possible so that the roofer can explain how the class provided the required training.

D. Provide students with objective sheet; discuss unit and specific objectives.

E. Provide students with information, assignment, and job sheets.

SUGGESTED ACTIVITIES

F. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Section I to discuss terms associated with roofing.

   SUGGESTIONS:

   - Show the class actual samples of equipment and materials when appropriate.
   - Relate roofing terms to previous lessons on roof framing.

2. Use Information Sheet, Section II to discuss safety rules pertaining to roofing.

   SUGGESTIONS:

   - Have a roofer who has been injured on the job discuss roofing safety.
   - Use transparencies and assignment sheets from *Fundamentals of Carpentry*, "Safety and Basic First Aid," to reinforce safety rules.
   - Demonstrate the proper use of ladders, emphasizing the particular safety rules that pertain to ladders in your training facility; point out safety labeling on ladders and address special dangers of using metal ladders around electrical wiring and power lines.
   - Put up safety posters emphasizing roofing safety.
   - Demonstrate the procedures in Job Sheet #1, emphasizing the need to test planks and properly install brackets; allow students to practice using Job Sheet #1.

     (NOTE: Talk to your class about vertigo and fears of heights. Stress that no one with such problems will have to do roof work and that the problems are nothing to be ashamed of. Offer to get counseling or other help for those who want it.)

   - Have students complete Job Sheet #1.
   - Review lifting techniques.
   - Demonstrate the safe use of all equipment, including conveyors, hoists, and tools.

3. Use Information Sheet, Section III to discuss parts of a roof, emphasizing parts not covered in roof framing and the relation of each part to installation of roofing.

SUGGESTED ACTIVITIES

SUGGESTIONS:

- Use Transparency #1 or show the class a model roof to point out the various roof parts.
- Discuss sheathing, underlayment, and finish roofing to introduce remaining information.

4. Use Information Sheet, Section IV to discuss types of traditional residential roof designs.

SUGGESTIONS:

- Take the class to visit home sites where the various designs can be seen; if at all possible, inspect the roofs to study the roofing installations; point out special requirements for flashing and other materials as well as special installation techniques.
- Emphasize roof designs common in your area.
- Provide students with roofing specifications from plans for the various roof designs.

5. Use Information Sheet, Section V to discuss classes of roofing.

SUGGESTIONS:

- Provide the class with samples of each class of roofing.
- Visit a roofing manufacturing plant or have a representative from a plant talk to the class.

  (NOTE: Most shingle manufacturers will provide you with samples of felt, granules, and raw materials used in the manufacturing process if there is no plant conveniently near your training facility.)
- Relate the various types of roofing to roof designs for which they are suitable.

6. Use Information Sheet, Section VI to discuss slope requirements.

SUGGESTIONS:

- Show the class Transparency #2.
- Use a sheet of plywood covered with asphalt shingles to demonstrate how water pools on the shingles at low slopes but runs off easily at steeper slopes.
- Relate slope to roof design as well as to type of roofing.

SUGGESTED ACTIVITIES

7. Use Information Sheet, Section VII to discuss types of roofing materials.

   SUGGESTIONS:

   - Show the class samples of the various types of roofing materials listed in this section of the information sheet.
   - Relate materials to the classes of roofing discussed in Section V of the information sheet.

8. Use Information Sheet, Section VIII to discuss types of asphalt shingles.

   SUGGESTIONS:

   - Show the class examples of each type of asphalt shingle and the manufacturer's instructions for each type.

     (NOTE: Discuss differences in materials, color variations, size variations, and self-sealing designs among manufacturers. Also emphasize variations between lot runs for a single manufacturer.)

   - Provide students with copies of Supplement #1 to expand your discussion.

9. Use Information Sheet, Section IX to discuss the definitions of wood shingles and wood shakes.

   SUGGESTIONS:

   - Show the class samples of each product; point out differences, including tooling marks on wood shingles.
   - Visit a manufacturer of wood shingles and shakes, or ask representatives from manufacturers to talk to the class.

     (NOTE: If wood shakes and shingles are not made in your area, a number of early-Americana exhibits demonstrate the hand-making of shakes.)

   - Provide students with copies of Supplements #2 and #3 to expand your discussion.

10. Use Information Sheet, Section X to discuss decking requirements for wood shingles and shakes.

    SUGGESTIONS:

    - Use a small model of spaced decking and loose shingles or shakes to explain the installation of wood shingles and shakes.
    - Visit a job site where wood shingles and shakes are being installed.

SUGGESTED ACTIVITIES

11. Use Information Sheet, Sections XI and XII to discuss guidelines for applying wood shingles and wood shakes.

    SUGGESTIONS:

    - Measure a shingle or shake and allow it to soak in water overnight to show the class how water causes it to swell.
    - Demonstrate the procedures in Job Sheet #3.

      (NOTE: Job Sheet #3 provides the student with practice on a small [10′ × 10′, for example] area, but the job sheet can be adapted to train the student for actual on-site installations.)
    - Have students complete Job Sheet #3.

12. Use Information Sheet, Section XIII to discuss guidelines for applying underlayment.

    SUGGESTIONS:

    - Show students Transparencies #3 and #4.
    - Show the class samples of the different types of underlayment and explain their uses.
    - Relate the importance of dry-in to underlayment application.

13. Use Information Sheet, Sections XIV and XV to discuss the requirements for applying flashing and the areas where flashing should be used.

    SUGGESTIONS:

    - Show the class Transparencies #5 through #9.
    - Visit construction sites to see flashing in place and being installed.
    - Demonstrate the cutting and shaping of flashing, emphasizing safe practices.
    - Discuss sealant requirements and demonstrate the application of sealants.

14. Use Information Sheet, Section XVI to discuss the types of materials used for flashing.

    SUGGESTIONS:

    - Show the class samples of the various materials used for flashing and emphasize the correct application of each type.

SUGGESTED ACTIVITIES

- Show the class different styles of flashing and discuss the various widths of roll flashing available; provide samples of flashing materials other than roll flashing.
- Exhibit vent stacks and other roofing products with attached flashing.

15. Use Information Sheet, Section XVII to discuss roofing equipment and tools, showing a sample of and demonstrating the use of each piece of equipment.

    (NOTE: Cover this information when required to support your overall presentation.)

16. Use Information Sheet, Sections XVIII, XIX, and XX to discuss the installation of asphalt shingles.

    SUGGESTIONS:

    - Show the class Transparencies #13 through #15.
    - Explain reasons for the various patterns of shingle layout.
    - Demonstrate each pattern, including the procedures in Job Sheet #2.
    - Have students complete Job Sheet #2.

17. Use Information Sheet, Section XXI to discuss estimating roofing materials needed for a three-tab asphalt-shingle roof.

    SUGGESTIONS:

    - Discuss units of sale for roofing materials or invite a building materials supplier to do so.
    - Show the class Transparencies #10 through #12 and Supplement #4.
    - Discuss Assignment Sheet #1.
    - Have students complete Assignment Sheet #1.

G. Review unit.

H. Give test.

I. Critique test and discuss in class.

J. Reteach if necessary.

K. Complete appropriate sections of competency profiles.

SUGGESTED ACTIVITIES

III. Unit references

A. Hepler, Donald E., and Paul I. Wallach. *Architecture: Drafting and Design,* 3rd ed. New York: McGraw-Hill Book Company, 1977.

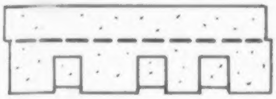
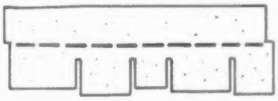
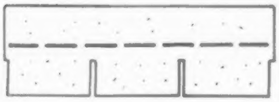
B. Novicic, Jovan. *Roofing Three: Steep Roofing.* Stillwater, Oklahoma: Mid-America Vocational Curriculum Consortium, Inc., for the Joint Apprenticeship Committee of the United Union of Roofers, Waterproofers and Allied Workers, and the National Roofing Contractors Association, 1981.

C. Ramsey, Charles G., and Harold R. Sleeper. *Architectural Graphic Standards,* 6th. ed. New York: John Wiley & Sons, Inc., 1970.

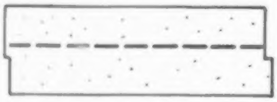
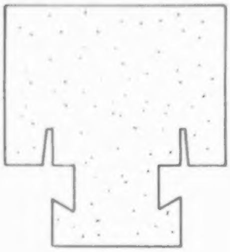
D. Wagner, Willis H. *Modern Carpentry.* South Holland, Illinois: Goodheart-Willcox Company, Inc., 1976.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — BASIC TYPES OF ASPHALT SHINGLES

			Per Square		Size (inches)			
Product	Configuration	Approximate Shipping Weight	Shingles	Bundles	Width	Length	Exposure	Underwriters' Listing
Wood-appearance strip shingle with more than one thickness per strip 	Various edge, surface-texture, and application treatments	285 lbs to 390 lbs	67 to 90	4 or 5	11 1/2" to 15"	36" or 40"	4" to 6"	A or C—many wind-resistant
Wood-appearance strip shingle with single thickness per strip 	Various edge, surface-texture, and application treatments	Various, 250 lbs to 350 lbs	78 to 90	3 or 4	12" or 12 1/4"	36" or 40"	4" to 5 1/8"	A or C—many wind-resistant
Strip shingle with tabs 	Conventional three-tab	205 lbs to 240 lbs	78 or 80	3	12" or 12 1/4"	36"	5" or 5 1/8"	A or C—all wind-resistant
	Two- or four-tab	Various, 215 lbs to 325 lbs	78 or 80	3 or 4	12" or 12 1/4"	36"	5" or 5 1/8"	

SUPPLEMENT #1
(Continued)

			Per Square		Size (inches)			
Product	Configuration	Approximate Shipping Weight	Shingles	Bundles	Width	Length	Exposure	Underwriters' Listing
Strip shingle without tabs 	Various edge and texture treatments	Various, 215 lbs to 290 lbs	78 to 81	3 or 4	12″ or 12 ¼″	36″ or 36 ¼″	5″	A or C—all wind-resistant
Individual lockdown shingle 	Several design variations	180 lbs to 250 lbs	72 to 120	3 or 4	18″ to 22 ¼″	20″ to 22 ½″	—	C—many wind-resistant

SUGGESTED ACTIVITIES

SUPPLEMENT #2 — STANDARDS FOR WOOD SHINGLES

Grade	Length	Thickness (at Butt)	No. of Courses per Bundle	Bdls/ Cartons per Square	Description
No. 1	16" (Fivex)	.40"	20/20	4 bdls	The premium grade of shingles for roofs and sidewalls. These top-grade shingles are 100% heartwood, 100% clear, and 100% edge-grain.
	18" (Perfections)	.45"	18/18	4 bdls	
	24" (Royals)	.50"	13/14	4 bdls	
No. 2	16" (Fivex)	.40"	20/20	4 bdls	A good grade for many applications. Not less than 10" clear on 16" shingles, 11" clear on 18" shingles, and 16" clear on 24" shingles. Flat grain and limited sapwoods are permitted in this grade.
	18" (Perfections)	.45"	18/18	4 bdls	
	24" (Royals)	.50"	13/14	4 bdls	
No. 3	16" (Fivex)	.40"	20/20	4 bdls	A utility grade for economy applications and secondary building. Not less than 6" clear on 16" and 18" shingles, 10" clear on 24" shingles.
	18" (Perfections)	.45"	18/18	4 bdls	
	24" (Royals)	.50"	13/14	4 bdls	
No. 4	16" (Fivex)	.40"	14/14 or 20/20	2 bdls 2 bdls	A utility grade for undercoursing on double-coursed sidewall applications or for interior accent walls.
	18" (Perfections)	.45"	14/14 or 18/18	2 bdls 2 bdls	
No. 1 or No. 2	16" (Fivex)	.40"	33/33	1 carton	Same specifications as above for No. 1 and No. 2 grades but machine-trimmed for exactly parallel edges with butts sawn at precise right angles. For sidewall application where tightly fitting joints are desired. Also available with smooth, sanded face.
	18" (Perfections)	.45"	28/28	1 carton	
	24" (Royals)	.50"	13/14	4 bdls	

SUGGESTED ACTIVITIES

SUPPLEMENT #3 — STANDARDS FOR WOOD SHAKES

Table 1

Grade	Length	Thickness (at Butt)	Number of Courses per Carton	Cartons per Square*	Description
No. 1 — machined grooved	16" 18" 24"	.40" .45" .50"	16/17 14/14 12/12	2 cartons 2 cartons 2 cartons	These shakes are manufactured from shingles and have striated faces and parallel edges. They are used exclusively double-coursed on sidewalls.

*Also marked in one-carton squares

Table 2

Grade	Length and Thickness	Number of Courses per Bundle	Number of Bundles per Square	Description
		18" Pack *		
No. 1 — hand-split and resawn	Starter-finish — 15"	9/9	5	These shakes have split faces and sawn backs. Cedar logs are first cut into desired lengths. Blanks or boards of proper thickness are split and then run diagonally through a band saw to produce two tapered shakes from each blank.
	Mediums — 18" × 1/2"	9/9	5	
	Heavies — 18" × 3/4"	9/9	5	
	24" × 3/8"	9/9	5	
	Mediums — 24" × 1/2"	9/9	5	
	Heavies — 24" × 3/4"	9/9	5	
No. 1 — taper-split	24" × 1/2"	9/9	5	These shakes are produced largely by hand, using a sharp-bladed steel froe and a wooden mallet. The natural shinglelike taper is achieved by reversing the block, end-for-end, with each split.
		20" Pack		
No. 1 — straight-split	True-edge** — 18" × 3/8"	14 Straight	4	These shakes are produced in the same manner as taper-split shakes, except that they are split from the same end of the block. The shakes acquire the same thickness throughout.
	18" × 3/8"	19 Straight	5	
	24" × 3/8"	16 Straight	5	

*Pack used for majority of shakes

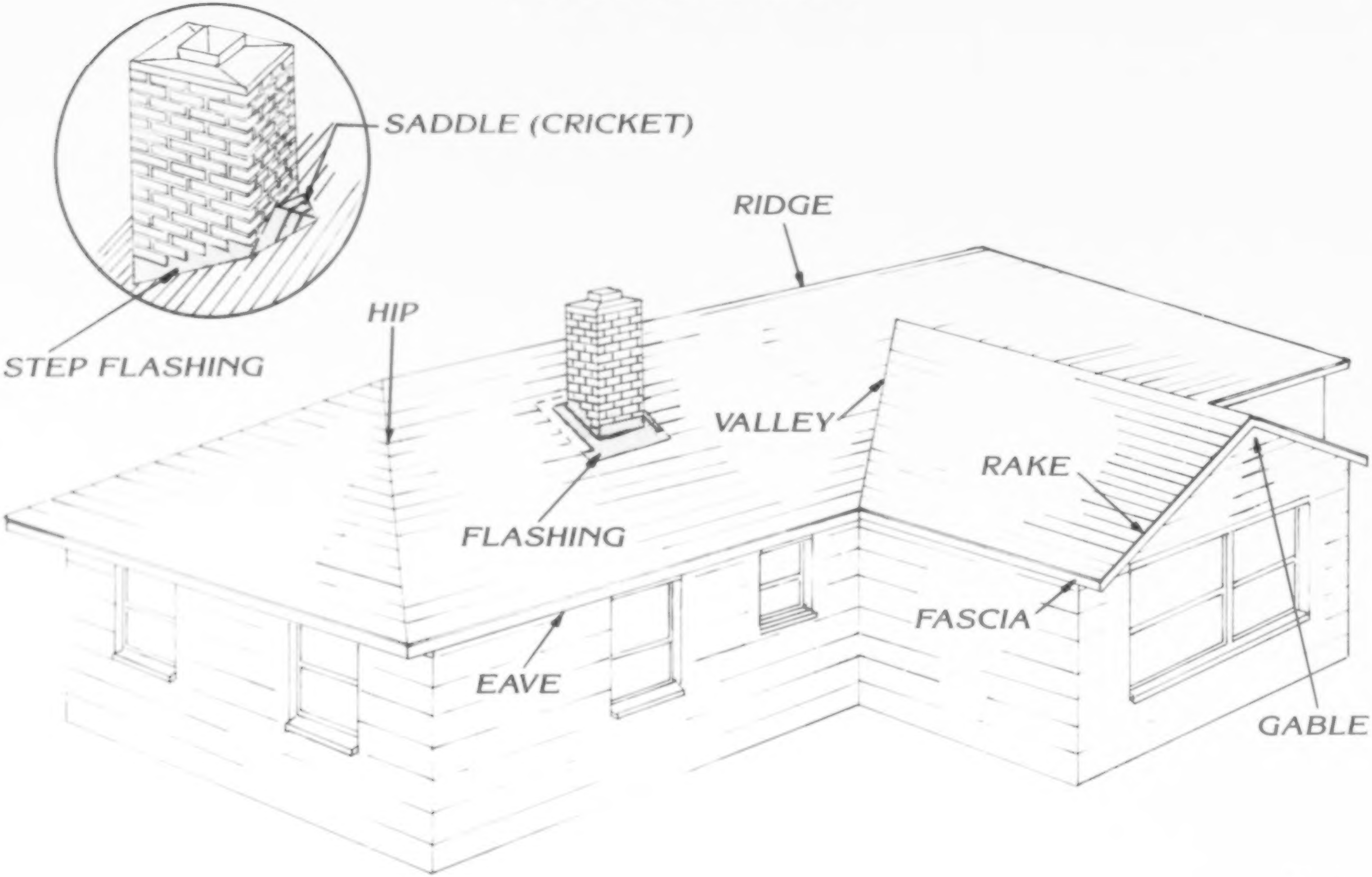
**Exclusively sidewall product with parallel edges

SUGGESTED ACTIVITIES

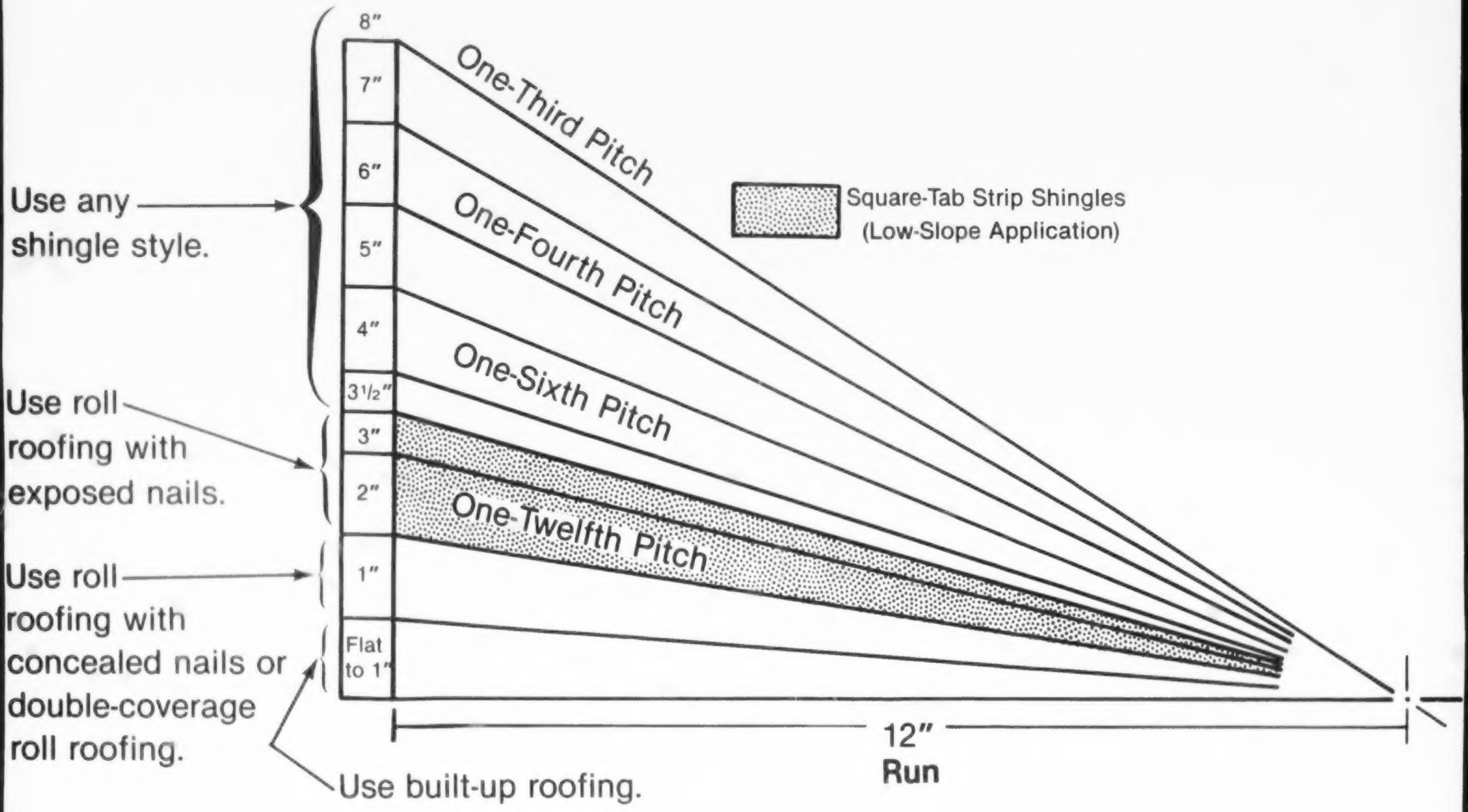
SUPPLEMENT #4 — ROOFING HARDWARE AND FASTENERS

Roofing Material	Type of Nail or Fastener	Size	Comments
Wood shingles and shakes	Nails or staples	3d, 4d, 5d, 6d, or equal-size staples	Fasteners should be rust-resistant (galvanized aluminum, zinc-coated).
Asphalt shingles and roll roofing	Plain, barbed nails Angular-thread nails Spiral-thread nails Galvanized roofing nails Nails with tin washers Felt nails	1" to 1¾"	—
Slate and tile roofing	Rust-resistant nails Snow guards Hurricane clips Metal repair straps Eave-closure strip	1¼" to 1¾"	Hurricane clips should be used where winds over 70 miles per hour are likely to occur.
	Soft copper wire	14-gauge	
Metal roofing	Copper clips or cleats and nails Terne cleats and nails TCZ interlocking cleats and nails Self-tapping drive, or sheet-metal screws Bolts, bolts and clips Lead-head bolts Nails with lead or neoprene washers	—	—
Miscellaneous roof applications	Metal drip edge Metal gravel stop	—	—

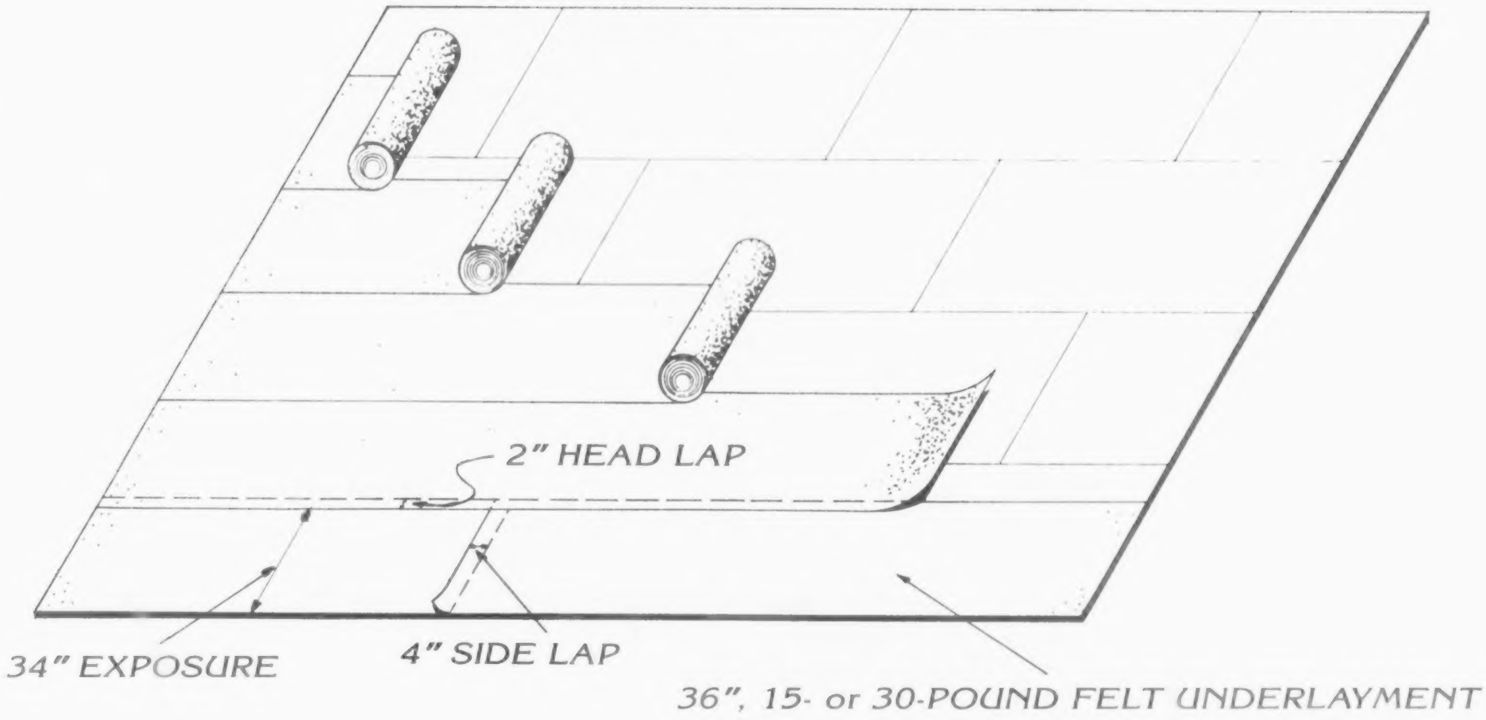
Parts of a Roof


SADDLE (CRICKET)
RIDGE
HIP
STEP FLASHING
VALLEY
RAKE
FLASHING
FASCIA
EAVE
GABLE

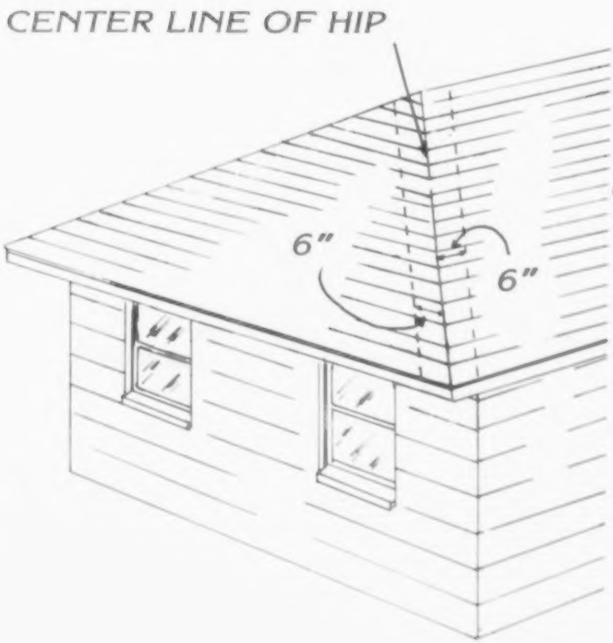
Minimum Slope Requirements for Various Roof Applications

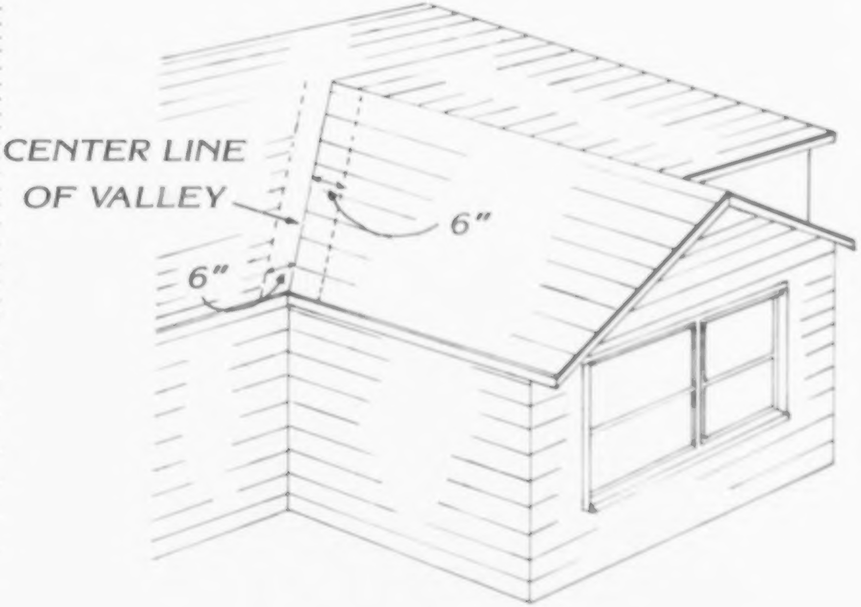

Roofing Material
Slope
8″
7″
6″
5″
4″
3½″
3″
2″
1″
Flat to 1″
One-Third Pitch
One-Fourth Pitch
One-Sixth Pitch
One-Twelfth Pitch
Square-Tab Strip Shingles (Low-Slope Application)
Use any shingle style.
Use roll roofing with exposed nails.
Use roll roofing with concealed nails or double-coverage roll roofing.
Use built-up roofing.
12″
Run

Underlayment Installation


2" HEAD LAP
34" EXPOSURE
4" SIDE LAP
36", 15- or 30-POUND FELT UNDERLAYMENT

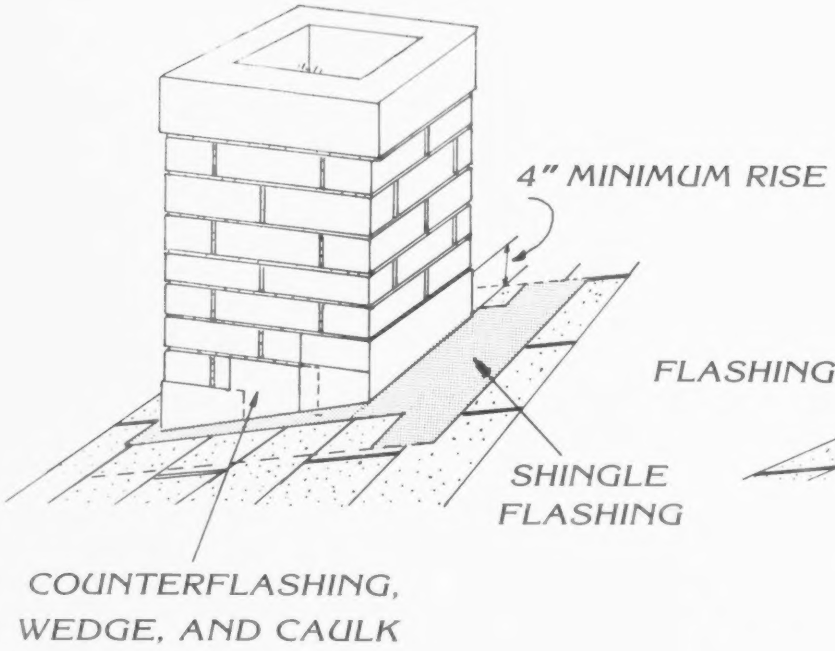
Underlayment Installation at Hips and Valleys

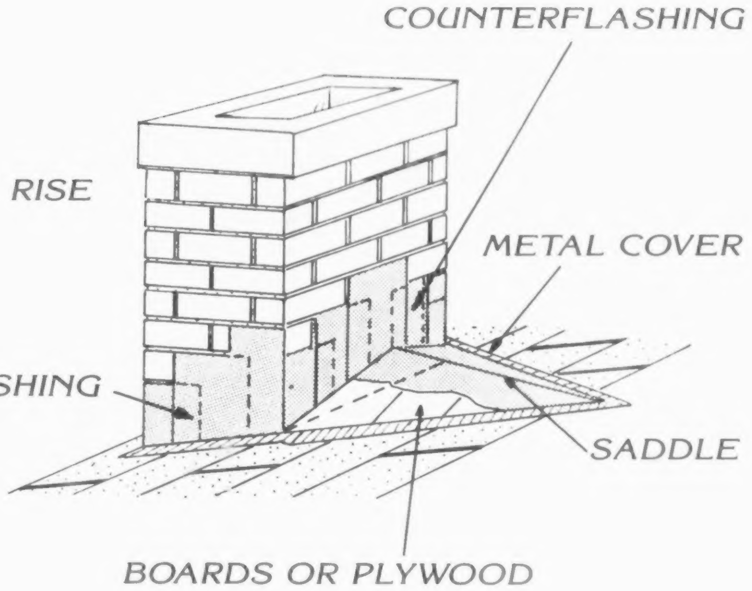

CENTER LINE OF HIP
6"
6"


CENTER LINE
OF VALLEY
6"
6"

EXTEND UNDERLAYMENT 6 INCHES PAST THE CENTER LINE OF HIPS AND VALLEYS.

Chimney Flashing

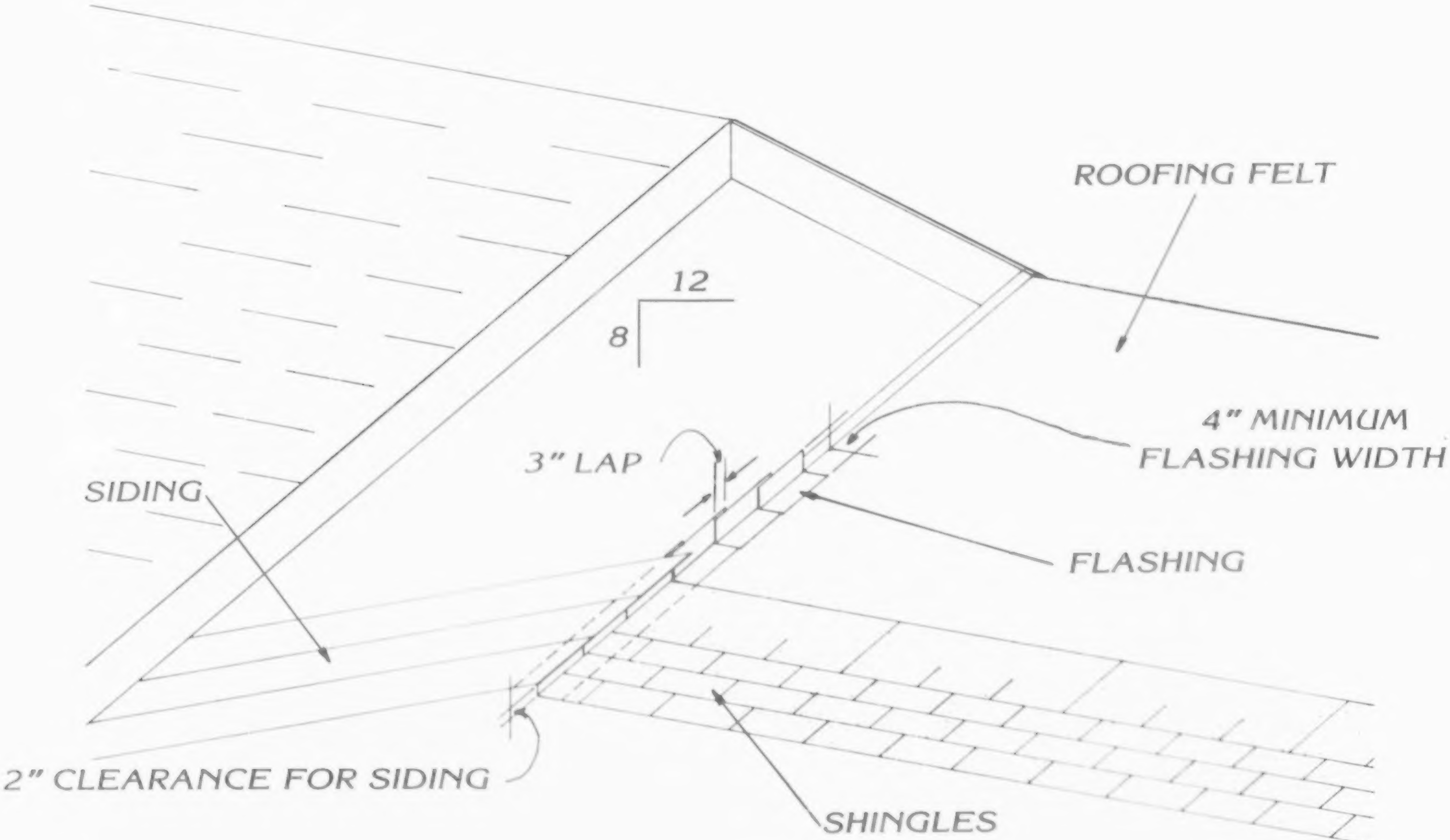

4" MINIMUM RISE
SHINGLE FLASHING
COUNTERFLASHING, WEDGE, AND CAULK


COUNTERFLASHING
METAL COVER
FLASHING
SADDLE
BOARDS OR PLYWOOD

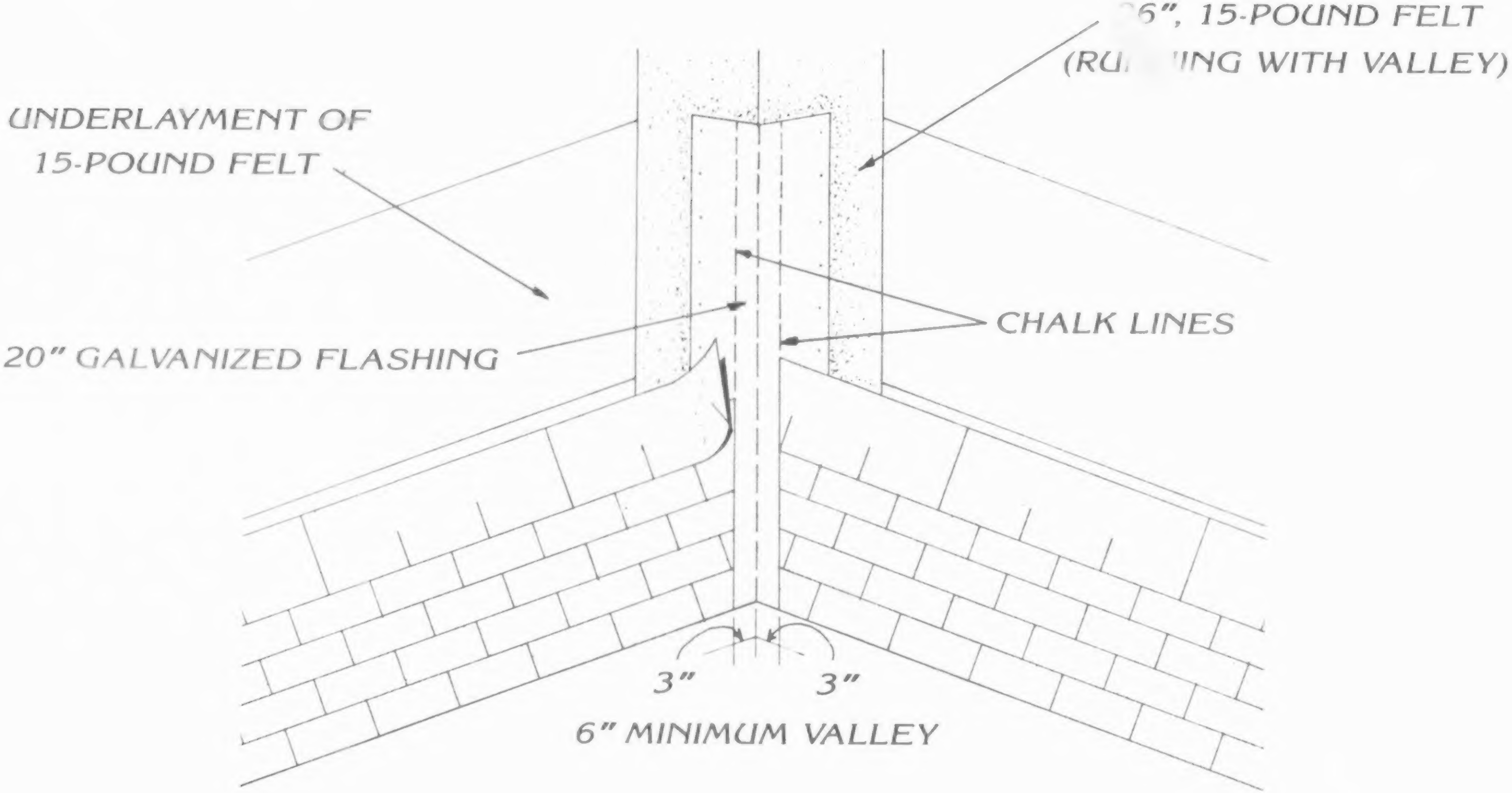
TM #5

RC - 93-E

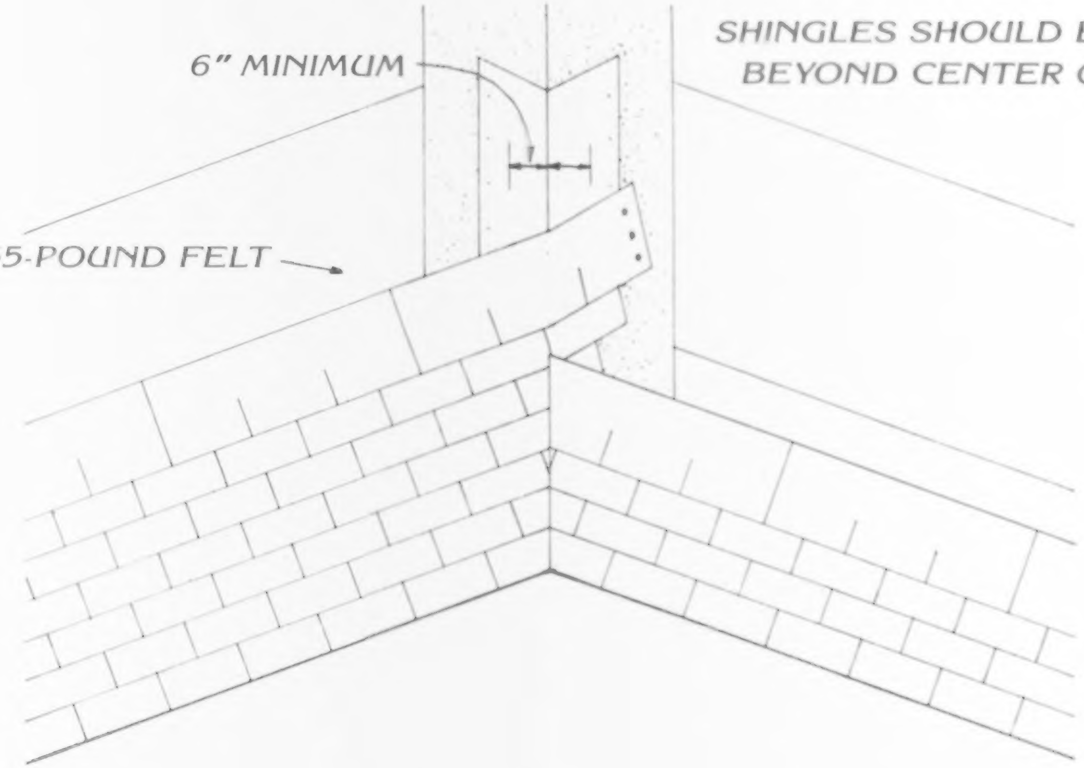
Flashing at Wall Intersection


ROOFING FELT
12
8
4" MINIMUM
FLASHING WIDTH
3" LAP
SIDING
FLASHING
2" CLEARANCE FOR SIDING
SHINGLES

Open-Valley Flashing


36", 15-POUND FELT
(RUNNING WITH VALLEY)
UNDERLAYMENT OF
15-POUND FELT
CHALK LINES
20" GALVANIZED FLASHING
3"
3"
6" MINIMUM VALLEY

Closed-Valley Flashing with Asphalt Shingles



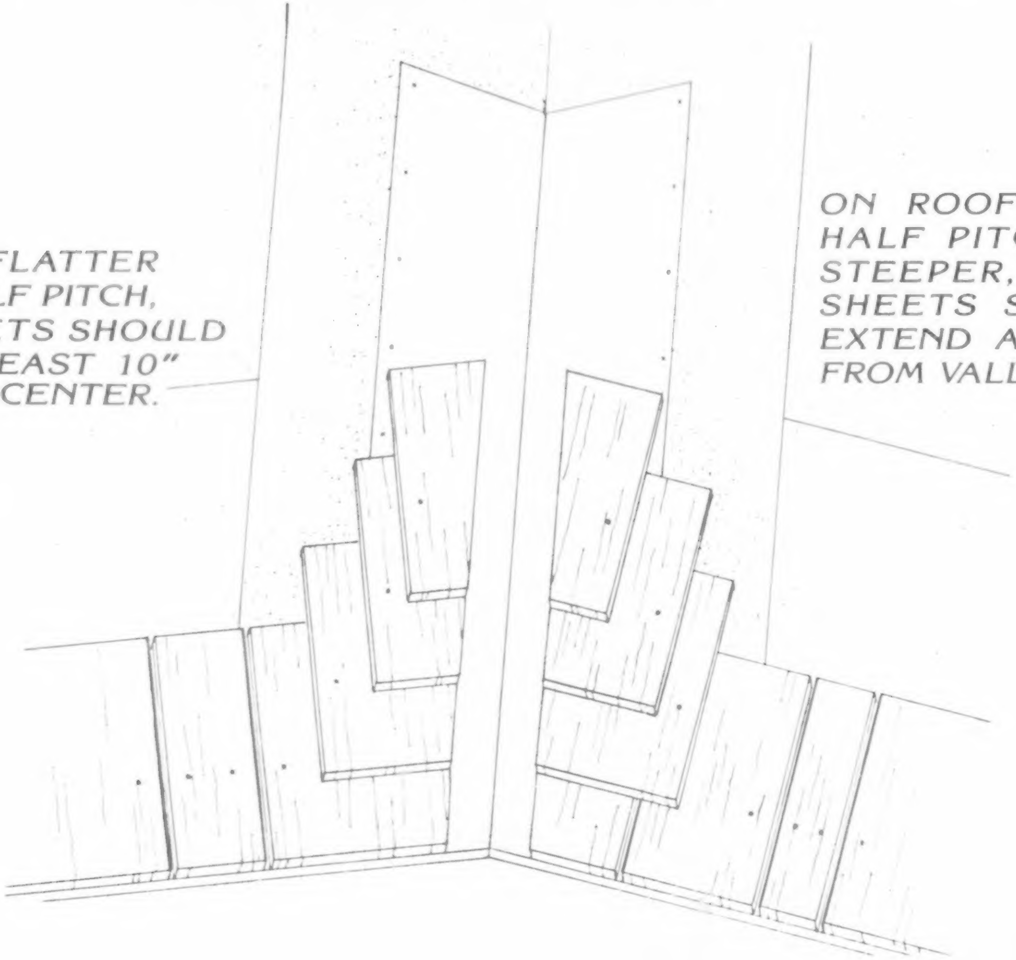
6" MINIMUM

36", 55-POUND FELT

SHINGLES SHOULD EXTEND 12" BEYOND CENTER OF VALLEY.

DO NOT NAIL IN CENTER OF VALLEY. TO STAY OUT OF CENTER OF VALLEY, NAIL NO CLOSER THAN 6 INCHES FROM CENTER LINE OF VALLEY.

Valley Flashing for Wood Shingles or Shakes



ON ROOFS FLATTER THAN ONE-HALF PITCH, VALLEY SHEETS SHOULD EXTEND AT LEAST 10" FROM VALLEY CENTER.

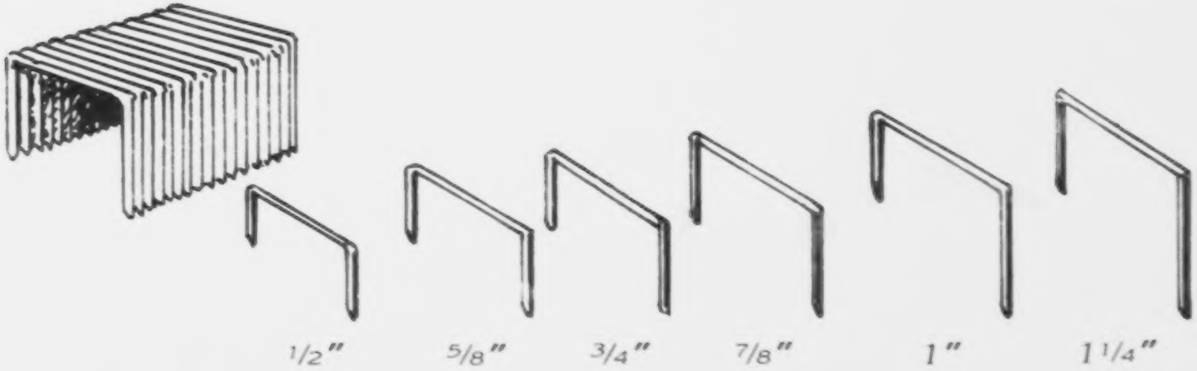
ON ROOFS AT ONE-HALF PITCH AND STEEPER, VALLEY SHEETS SHOULD EXTEND AT LEAST 7" FROM VALLEY CENTER.

TM #9

RC - 101-E

Roofing Fasteners

STAPLES

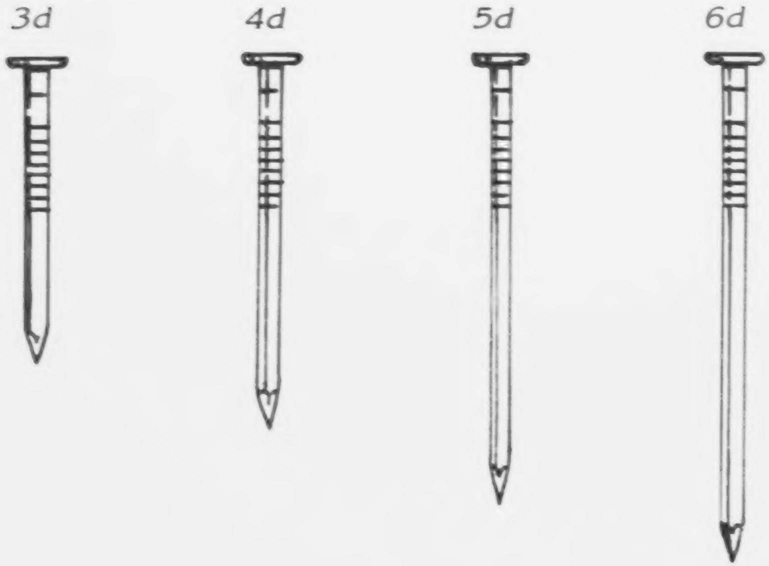


WIDE-CROWN ROOFING STAPLES HAVE A 1-INCH CROWN AND COME IN LENGTHS FROM 1/2 INCH TO 1 1/4 INCHES.

THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA

Roofing Fasteners
(Continued)

GALVANIZED BOX NAILS

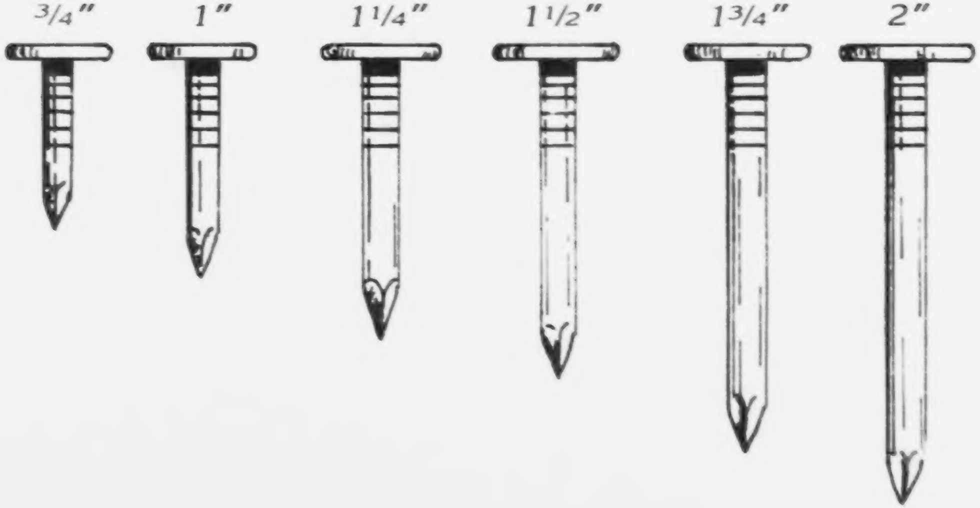


GALVANIZED BOX NAILS (SHINGLE NAILS) ARE USED TO FASTEN CEDAR AND SHAKE SHINGLES. THEY COME IN SIZES FROM 3d TO 6d, AS SPECIFIED BY THE PENNY SYSTEM.

Roofing Fasteners

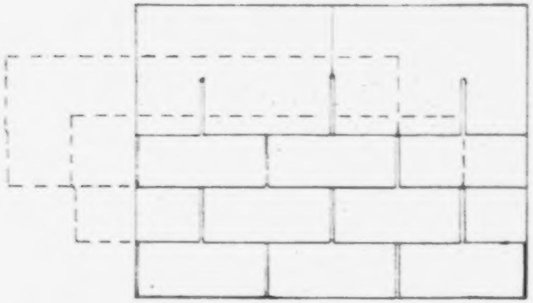
(Continued)

GALVANIZED ROOFING NAILS

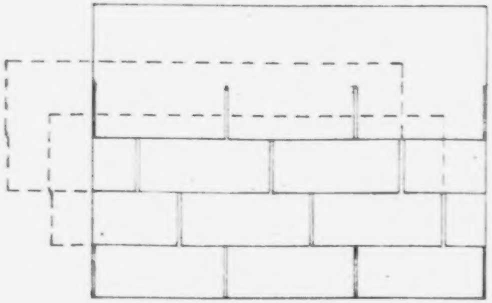


GALVANIZED ROOFING NAILS ARE NOT SPECIFIED BY THE PENNY SYSTEM; THEIR LENGTHS ARE MEASURED IN INCHES. TYPICAL SIZES ARE 3/4 INCH TO 2 INCHES. THEY HAVE LARGE HEADS.

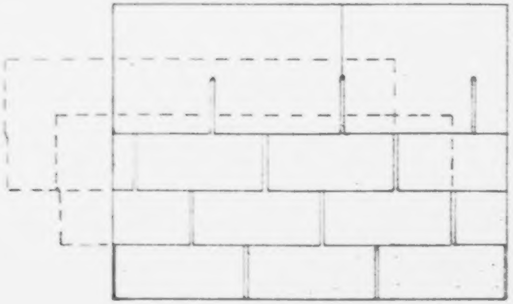
Asphalt-Shingle Installation Patterns



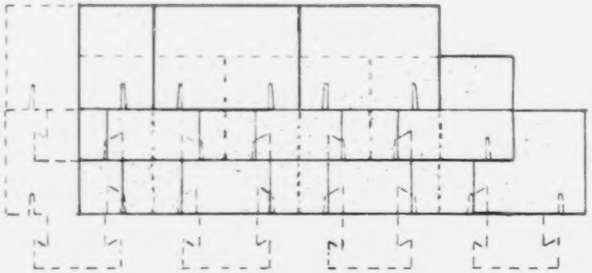
ONE-HALF BREAK TAB PATTERN



ONE-THIRD BREAK,
THREE-TAB PATTERN

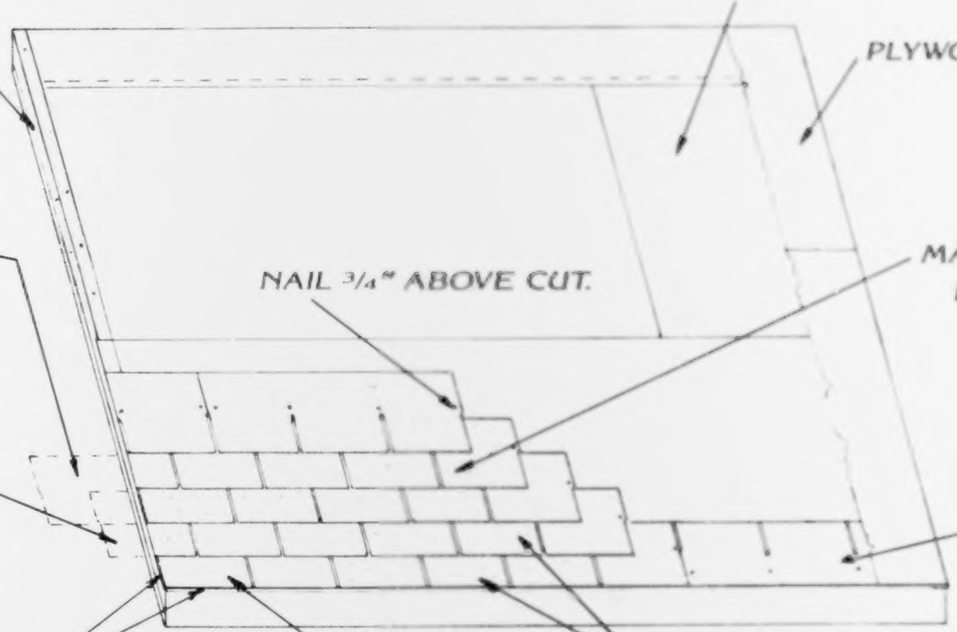


5-INCH BREAK,
THREE-TAB PATTERN



LOCK-TAB PATTERN

One-Half Break Asphalt-Shingle Installation Pattern


EAVE FLASHING STRIP
FELT
PLYWOOD SHEATHING
STARTER STRIP
THREE-TAB SQUARE-BUTT SHINGLES

START THIRD COURSE WITH A FULL STRIP MINUS FIRST TAB.

NAIL 3/4" ABOVE CUT.

FOLLOW MANUFACTURER'S RECOMMENDED EXPOSURE

START SECOND COURSE WITH A FULL STRIP MINUS ONE-HALF TAB.

SHINGLE OVERHANG SHOULD EXTEND 1" AT RAKE AND 1 1/2" AT EAVE.

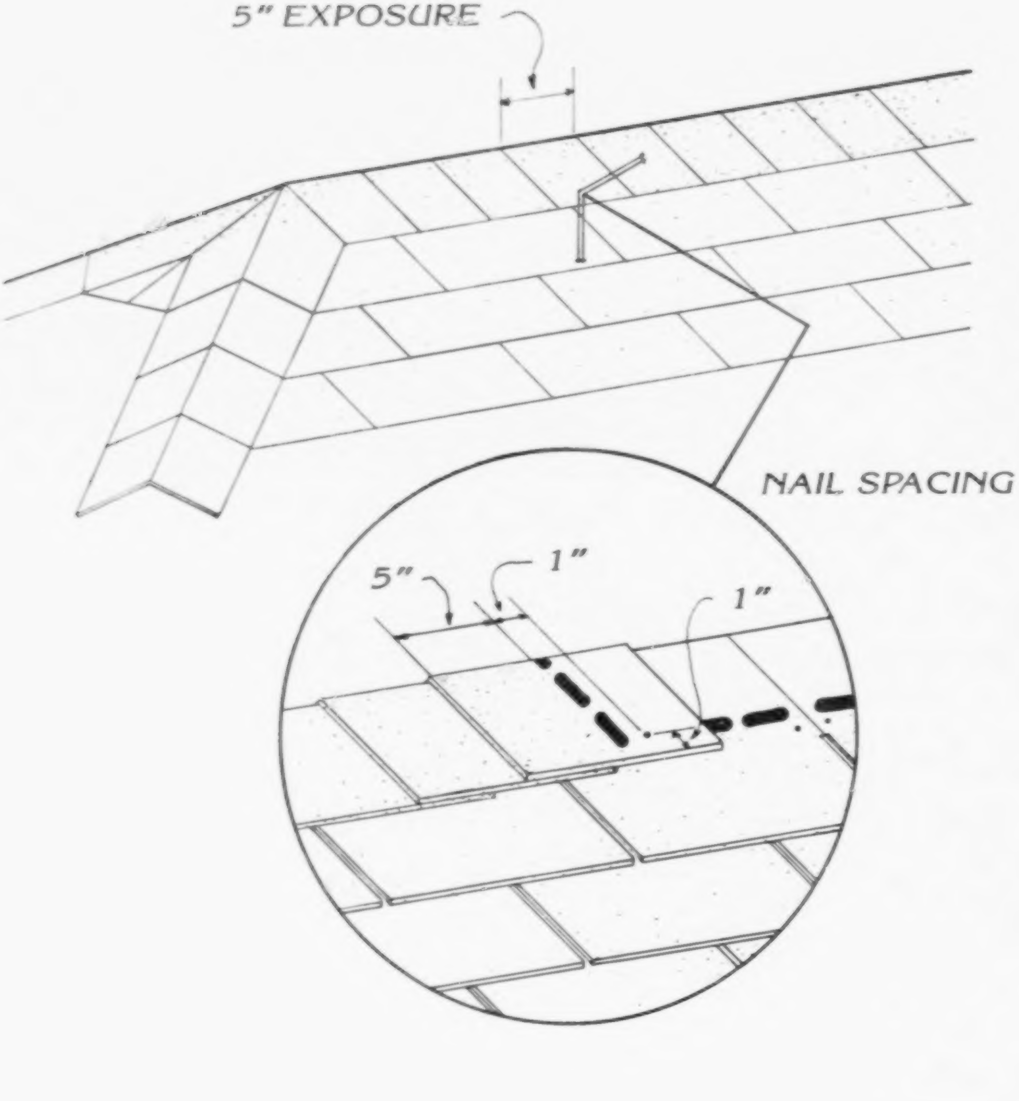
START FIRST COURSE WITH FULL STRIP.

TM #14

RC - 111-E

RC - 113-E

Installation of Hip and Ridge Shingles


5" EXPOSURE
NAIL SPACING
5"
1"
1"

TM #15

ROOF FINISHES
UNIT II

INFORMATION SHEET

I. Terms and definitions associated with roofing

A. Curb roof — Roof with ridge at center and double slope on each of its two sides

B. Built-up roof — Roof with several layers of felt or jute that are saturated with coal tar, pitch, or asphalt with a topping of aggregate

C. Square — Amount of roofing material needed to provide 100 square feet of finished roofing

D. Slope — Incline of roof as a ratio of vertical rise to horizontal run

EXAMPLE: If the roof rises at the rate of 4 inches for each foot of run, it is designated as having a 4 in 12 slope.

E. Wood shakes — Shingles split from logs and shaped for commercial use

F. Butt edge — Bottom edge of shingle

G. Cutout (water channel) — Slot or opening in tab shingle

H. Mineral surface — Rock granules that cover asphalt-coated composition roofing

I. Exposure — Portion of shingle that is subjected to weathering

J. Flashing — Material (usually sheet metal) used to prevent rain or other moisture from entering structure

K. Terne metal — Material made of copper-bearing steel that has been heat-treated to provide best balance between malleability and toughness

L. Drip edge — Edge of roof from which water drips into gutter or into the open

M. Spaced deck sheathing — 1×4 boards that are nailed to rafters with spacings equal to width of boards

N. Ladder jack — Brace that supports scaffold plank between two ladders

O. Roof bracket — Brace that is used on roof to support scaffold planks, which are used as a work platform

II. Safety rules pertaining to roofing

A. Appropriate dress

1. Wear goggles

2. Wear hard hats as required

3. Wear ankle-high work shoes with nonskid soles

(NOTE: In some areas and under certain circumstances, tennis shoes are recommended.)

INFORMATION SHEET

4. Wear gloves as required
5. Wear protection against the elements

B. Ladder safety

1. Inspect ladders before they are sent to job site
2. Select the right ladder for the job

   EXAMPLE: On a building 16 feet high, a standard 28-foot extension ladder is best for the job since the base of the ladder has to be away from the building 1 foot for every 4 feet of building height and still reach a minimum of 3 feet above the eave of the roof.

3. Tie off ladders at top
4. Be sure all ladders are equipped with safety shoes
5. Secure ladders at bottom if they extend more than 3 feet above roof line

C. Scaffold safety

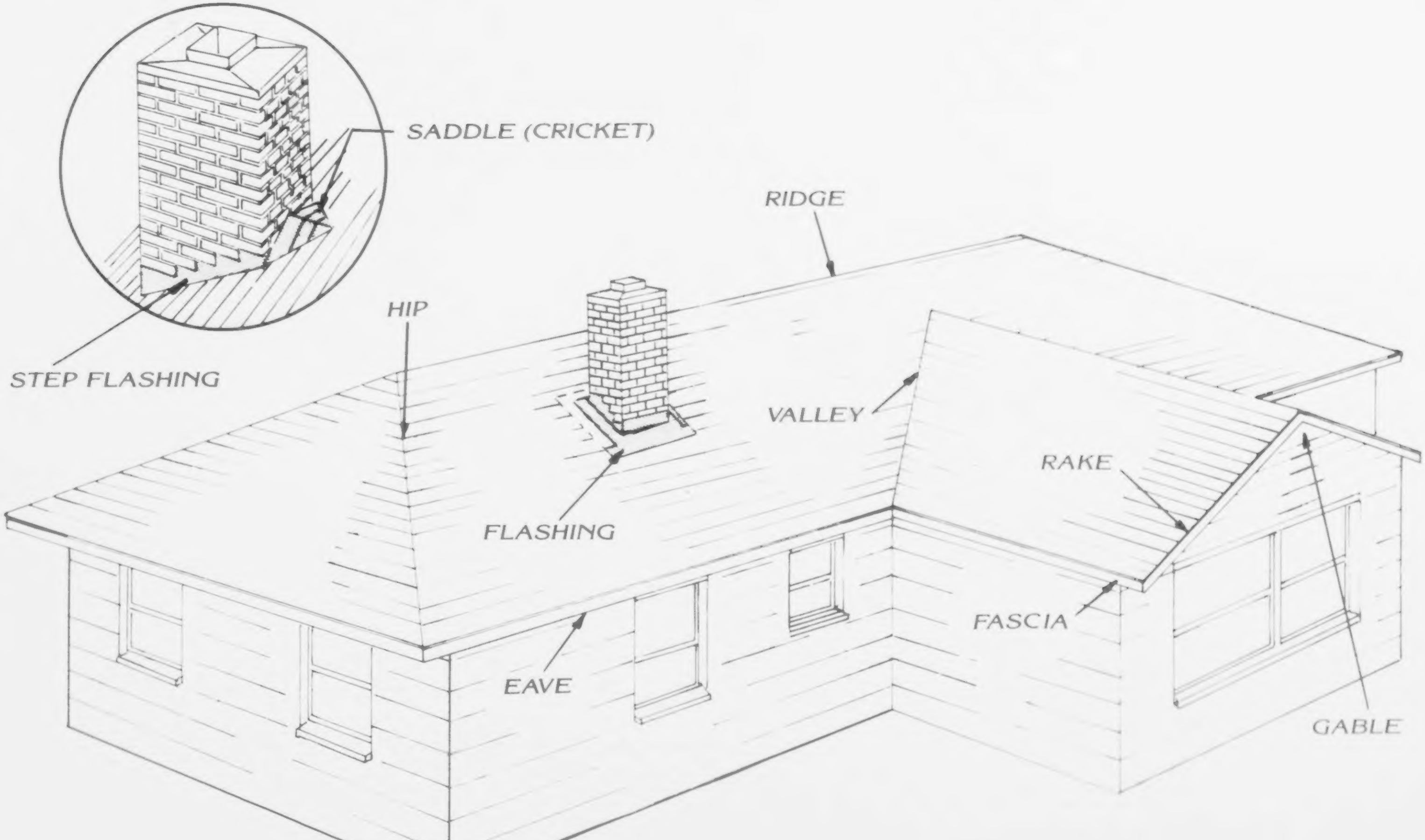
1. Test scaffold planks before sending them to job site
2. Be sure scaffold planks are properly secured to properly attached roof brackets
3. Always use nails through *all* holding slots on roof brackets
4. Nail roof brackets into rafters whenever possible
5. Secure scaffold planks to ladder jacks with rope or heavy-gauge wire

D. Tools and materials

1. Stay within load limits of equipment being used
2. *Do not* let anyone walk under load that is being hoisted
3. Never overload one section of roof with materials; distribute materials evenly over entire roof area
4. Lift heavy materials correctly
5. Never carry utility knife in your pocket; keep knife in its holster
6. Handle hatchets carefully
7. Do not use power fasteners until you have read manufacturer's instructions and passed safety test

III. Parts of a roof (Figure 1)

FIGURE 1


SADDLE (CRICKET)
RIDGE
HIP
STEP FLASHING
VALLEY
RAKE
FLASHING
FASCIA
EAVE
GABLE

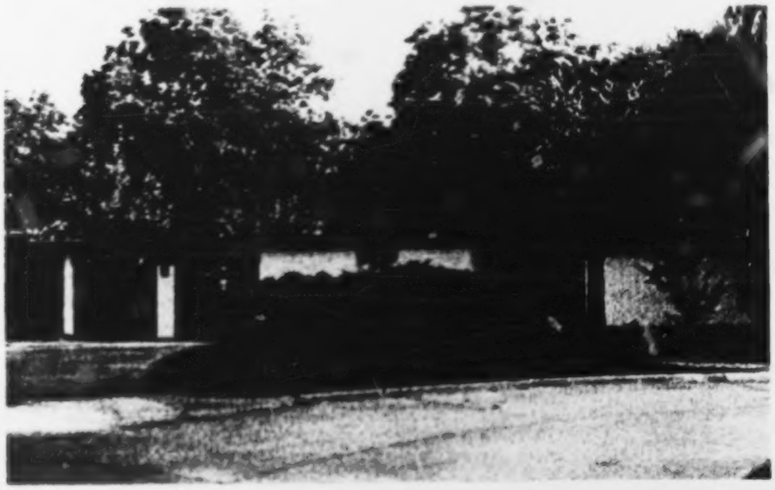
INFORMATION SHEET

IV. Traditional residential roof designs (Figures 2 - 7)

A. Flat

(Note: A flat roof is pitched only enough to provide drainage.)

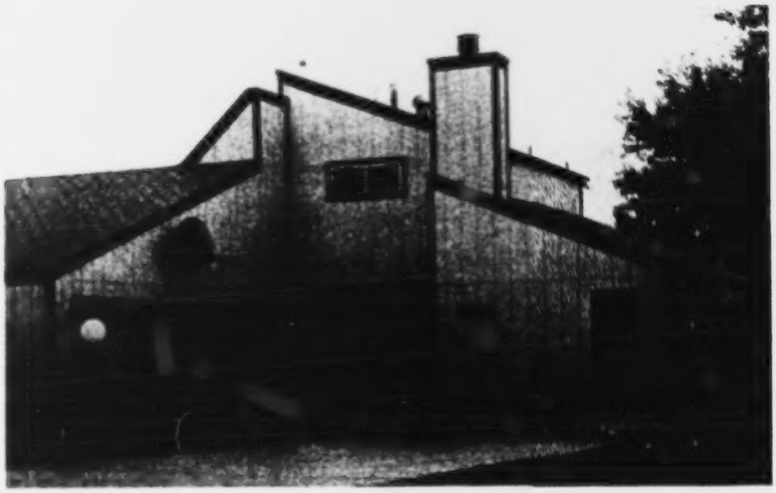
FIGURE 2



B. Monopitched

(NOTE: A monopitched roof has a series of shed roofs that may slope in several directions.)

FIGURE 3



INFORMATION SHEET

C. Gable

(NOTE: A gable roof is a double-sloping roof that forms a gable at each end.)

FIGURE 4

D. Hip

(NOTE: A hip roof has sloping ends and sloping sides.)

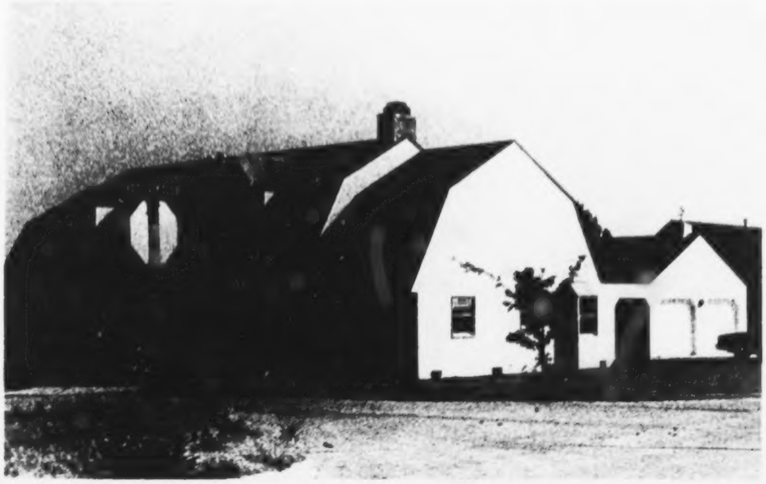
FIGURE 5

INFORMATION SHEET

E. Gambrel

(NOTE: A gambrel roof is a curb roof with two slopes: a lower steeper slope and an upper flatter slope.)

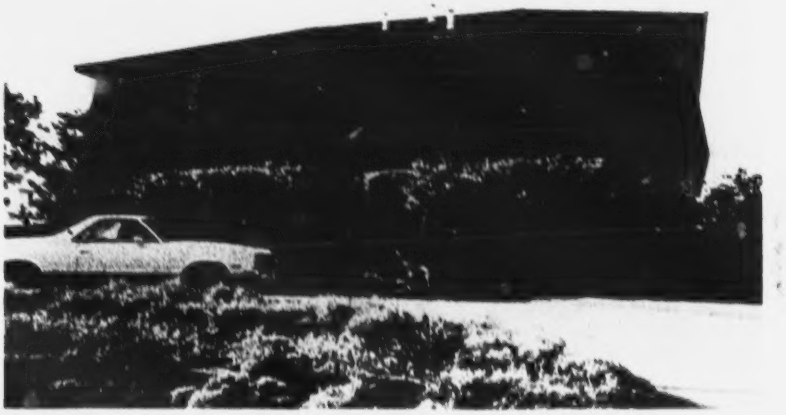
FIGURE 6



F. Mansard

(NOTE: A mansard roof, like a gambrel roof, has two slopes but the ends also slope.)

FIGURE 7



INFORMATION SHEET

V. Classes of roofing

- A. Shingle roofing

  (NOTE: Shingle roofing includes both wood shingles and shakes and composition shingles.)

- B. Roll roofing
- C. Tile roofing
- D. Built-up roofing
- E. Metal roofing

  (NOTE: Metal roofing can be either corrugated and crimped or seamed, and the seamed type is available in three styles: standing-seam, flat-seam, and batten-seam.)

- F. Formed-glass roofing
- G. Polyurethane-foam roofing

VI. Minimum slope requirements and their specific roofing applications

- A. From flat to 1 in 12—Use built-up roofing
- B. From 1 to 2 in 12—Use roll roofing with concealed nails or double-coverage roll roofing
- C. From 2 to 3 in 12—Use roll roofing with exposed nails
- D. From 3½ in 12 to vertical—Use any style of shingle roofing

VII. Types of roofing materials

- A. Wood
- B. Asphalt
- C. Rosin sheathing
- D. Mineral fiber
- E. Hot asphalt, coal tar, pitch, and aggregate
- F. Fiberglass
- G. Nonreinforced plastic
- H. Vinyl
- I. Structural glass
- J. Porcelain
- K. Clay
- L. Slate
- M. Concrete
- N. Stainless steel
- O. Zinc alloy
- P. Titanium-copper
- Q. Tin
- R. Lead
- S. Galvanized iron
- T. Terne metal
- U. Copper

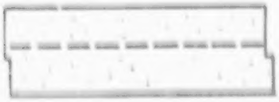
INFORMATION SHEET

VIII. Basic types of asphalt shingles (Figures 8 - 12)

(NOTE: A modern strip shingle is normally impregnated with a sealant that holds down the tab of the course that has been laid over the shingle. The black dashes across the middles of the shingles illustrated below represent this self-sealing strip.)

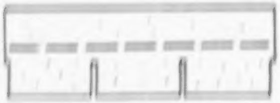
A. Strip shingle without tabs

FIGURE 8



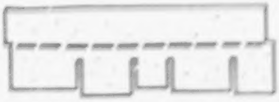
B. Strip shingle with tabs

FIGURE 9



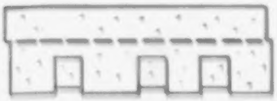
C. Wood-appearance strip shingle with single thickness per strip

FIGURE 10



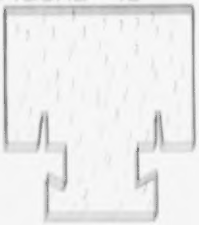
D. Wood-appearance strip shingle with more than one thickness per strip

FIGURE 11



E. Individual lockdown shingle

FIGURE 12



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INFORMATION SHEET

IX. Definitions of wood shingles and wood shakes

A. Wood shingles—Wood roofing products that are sawed in 16-, 18-, and 24-inch lengths and in uniform butt thicknesses per individual length

B. Wood shakes—Wood roofing products that are split from logs and roughly sawed in lengths and in various butt thicknesses per individual length

X. Decking requirements for applying wood shingles and wood shakes

(NOTE: Local building codes may place further restrictions on roof decking. Before applying any roofing, check the decking for delamination of plywood and warped boards, and check building codes for proper board spacing and proper nailing.)

A. Spaced decking

1. Use 1×4 sheathing boards

2. Space sheathing boards with no more distance between centers than maximum recommended weather exposure for shingle

3. Use breather-type building paper if underlayment is required

B. Solid decking — Use a minimum of ½-inch plywood decking

(NOTE: Solid decking may be preferable in locations where wind-driven snow conditions occur.)

XI. Guidelines for applying wood shingles

A. Double shingles at eaves and stagger shingles at joints

B. Extend first and starter courses a minimum of 1½ inches beyond finished fascia board or last sheathing board and 1 inch at gable ends

(NOTE: Reduce the extension [overhang] to 1 inch when gutters or eave troughs are used.)

C. Install shingles so that space between adjacent shingles (joint or slots) is no less than ¼ inch and no more than ⅜ inch

(NOTE: If shingles are wet, use smaller spacing; if shingles are dry, use larger spacing.)

D. Stagger joints in one course at least 1½ inches from joints in adjacent course

(NOTE: Joints in alternate courses should not be in direct alignment.)

E. Drive one nail no more than ¾ inch from each side of shingle and no more than 1½ inches above shingle's exposure line

(NOTE: Use no more than two nails, regardless of the width of the shingle.)

INFORMATION SHEET

F. Drive each nail so that head is flush with shingle surface; *do not* drive head into wood fiber

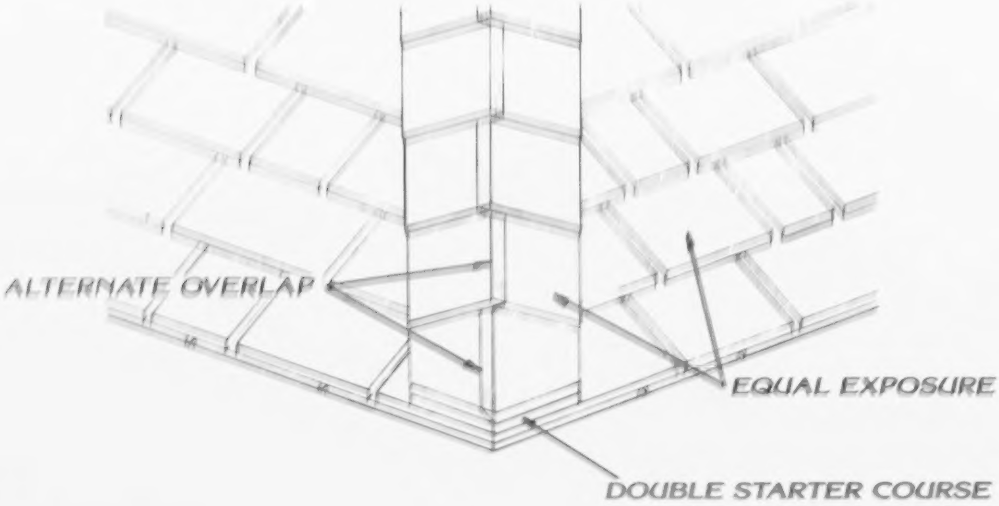
G. Cover hips and ridges with shingles that have a uniform width of 3 inches to 5 inches

H. Attach hip and ridge shingles with alternate overlaps and with an exposure equal to that of all preceding courses (Figure 13)

(NOTE: Manufactured hip and ridge units are available for use and are recommended for an economical and uniform application.)

EXAMPLE:

FIGURE 13



XII. Guidelines for applying wood shakes

A. Apply double layer of shakes at eaves and stagger shakes at joints

B. Use 15-inch or 18-inch wood shingles for starter course

C. Extend starter course a minimum of 1½ inches beyond finished fascia board or last sheathing board

(NOTE: Reduce the extension [overhang] to ¾ inch when gutters or eave troughs are used.)

D. Apply a 36-inch, 30-pound roofing felt at eave lines

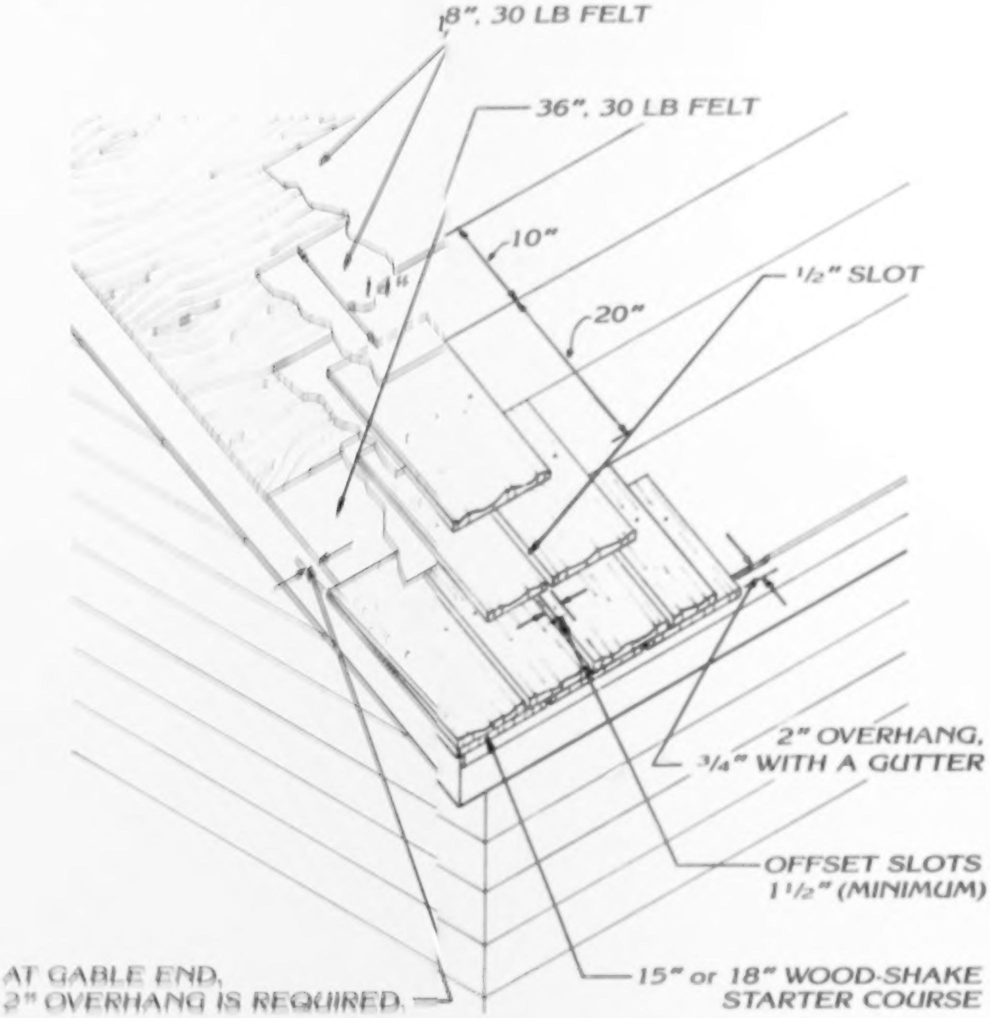
E. Lay an 18-inch strip of 30-pound roofing felt over top portion of each previously applied course of shakes, and be sure it extends onto the sheathing

INFORMATION SHEET

F. Apply felt so that bottom edge is equal to twice the distance of exposure

EXAMPLE: Twenty-four-inch shakes applied with a 10-inch exposure require that the felt be applied 20 inches above the butt of the shakes; this allows 14 inches of felt to extend onto the sheathing. See Figure 14.

FIGURE 14


18", 30 LB FELT
36", 30 LB FELT
10"
14"
20"
1/2" SLOT
2" OVERHANG,
3/4" WITH A GUTTER
OFFSET SLOTS
1 1/2" (MINIMUM)
15" or 18" WOOD-SHAKE
STARTER COURSE
AT GABLE END,
2" OVERHANG IS REQUIRED.

STAIR-STEP METHOD OF APPLYING SHAKES

G. Space shakes so that joint between each shake is 1/2 inch and so that joint between adjacent courses is offset a mininum of 1 1/2 inches (See Figure 14)

H. Allow 2-inch overhang at gable ends (See Figure 14)

INFORMATION SHEET

- I. Drive one nail no more than 1 inch from each side of shake and about 2 inches above butt line of following course

  (NOTE: No more than two nails should be used, regardless of the width of the shingle.)

- J. Drive each nail so that head is flush with shake surface; *do not* drive head into wood fiber

- K. Cover hips and ridges with shakes having a uniform width of 4 inches to 6 inches

- L. Attach hip and ridge shakes with alternate overlaps and with an exposure equal to that of all preceding courses

  (NOTE: Manufactured hip and ridge units are available and are recommended for an economical and uniform application.)

XIII. Guidelines for applying underlayment

(NOTE: The most common roofing underlayments are asphalt and saturated felt. Underlayment provides an additional barrier against moisture, wind, and wind-driven snow.)

- A. Lap top of underlayment at least 2 inches
- B. Lap sides and ends of underlayment at least 4 inches
- C. Lap each side of center line at least 6 inches on hips and valleys

XIV. General requirements for applying flashing

- A. Apply valley and edge flashing before applying shingles
- B. Apply flashing at all intersections of different roof planes, all abutments of roof against adjoining walls, and all projections through roof surface

  (NOTE: Flashing seals the roof against leakage.)

- C. Apply flashing so that descending water will be carried over a joint, *not into it*

XV. Areas where flashing should be used

(NOTE: Flashing must be used wherever there is a change in roof slope, where there is a roof opening, or where there is a projection from the roof surface.)

- A. Valleys
- B. Vertical walls
- C. Chimneys

INFORMATION SHEET

D. Vent stacks

E. Roof vents

F. Skylights

XVI. Types of materials used for flashing

A. Aluminum

B. Copper

C. Galvanized metal

D. Lead

E. Roll roofing (50- to 90-pound mineral-surfaced asphalt)

F. Tin-coated metal

XVII. Uses of roofing equipment and tools

A. Extension ladder — Used to provide access to or exit from roof; also used in pairs to support ladder jacks and scaffold planks

B. Ladder jacks and scaffold plank — Used in pairs to form a working platform for loading material and a staging point for application procedures; also used as a safety barricade for tools or material that may fall from roof

C. Roof brackets and scaffold plank — Used in pairs to provide workers with a safe work area and a place to hold materials

(NOTE: Always use a third bracket when scaffold plank is more than 6 feet long. Brackets should never be more than 6 feet apart.)

D. Safety line — Used as a safety device on steep roofs

E. Hoisting equipment — Used to move material from ground or truck to roof, or from one location to another

EXAMPLES: Hand hoist, hand beam-hoist, swing beam-hoist, ladder-platform hoist, conveyor

F. Chalk line — Used to lay out work

G. Tool belt and nail bag — Used to hold hand tools and fasteners

H. Keel (marking crayon) — Used to mark lines and dimensions, to make marks indicating leaks or other defects, and to write special instructions

INFORMATION SHEET

I. Steel tape — Used to measure, check dimensions, and lay out work

J. Hatchet — Used to nail and cut shingles

(NOTE: A roofer's hatchet is a precisely balanced tool designed for shake and shingle installation.)

K. Utility knife — Used to cut felt, insulation, shingles, and roll roofing

L. Combination tin snips — Used to cut flashing materials

M. Pointing trowel or margin trowel — Used to apply mastic

N. Nailer or stapler — Used to power-attach fasteners

(NOTE: Electric- and pneumatic-powered nailers and staplers are available.)

XVIII. Guidelines for applying double starter course of asphalt shingles

A. Apply first row of asphalt shingles or 9-inch (or wider) strip of mineral-surfaced asphalt roll roofing along eave of roof

(NOTE: When applying the first row of a double starter course of self-sealing shingles, the exposed tab portion of the shingle may be cut off and the shingle reversed so that the self-sealing strip is up roof from the eave.)

B. Apply second row of shingles so that it overlaps bottom edge of eave as recommended by manufacturer

C. Fasten double starter course with roofing nails along a line that is parallel to and 3 to 4 inches above edge of eave

D. Space nails so that nailheads will not be exposed after first course of shingles is applied

XIX. Guidelines for applying shingles with cutouts that break joint in half

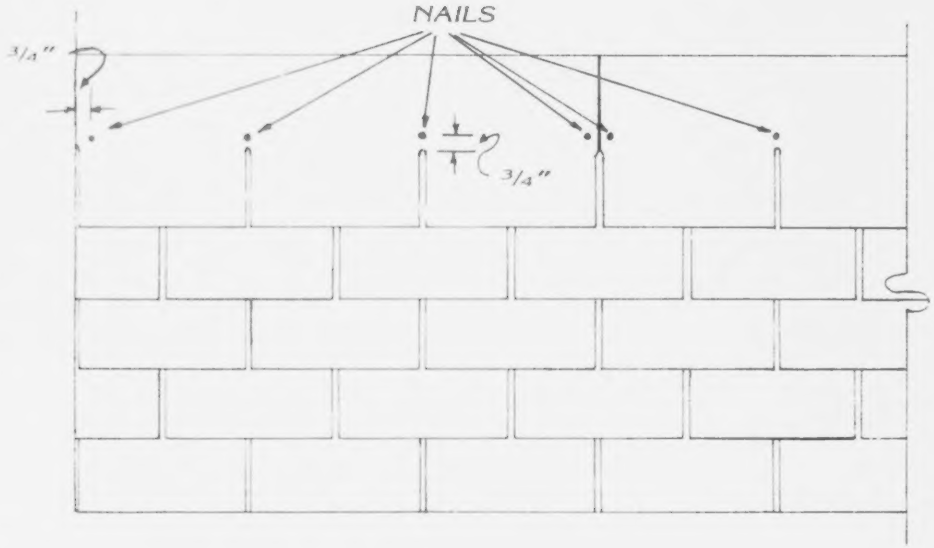
(NOTE: The guidelines given below are for shingles that are made so that the cutouts are centered on the tabs of the shingles in the course below. Various methods are used to apply this type of shingle. See manufacturer's recommendations on packages. Also, these guidelines apply to courses above the starter course; it is assumed that the metal drip edge and starter course have already been applied.)

A. Nail each shingle with four nails: one 3/4 inch above each cutout and one at each end approximately 3/4 inch in from the edge of shingle (See Figure 15)

INFORMATION SHEET

EXAMPLE:

FIGURE 15



B. Start first course with a full shingle, and apply all shingles so that lower edges of butts are aligned with bottom edge of starter course (See Figure 16)

C. Start second course with a full shingle minus one-half tab, and apply all shingles so that lower edges of butts are aligned with top of cutouts of underlying course (See Figure 16)

(NOTE: Cut 6 inches from the first shingle to eliminate one-half tab.)

D. Start third course with a full shingle minus first tab, and apply all shingles so that lower edges of butts are aligned with top of cutouts of underlying course (See Figure 16)

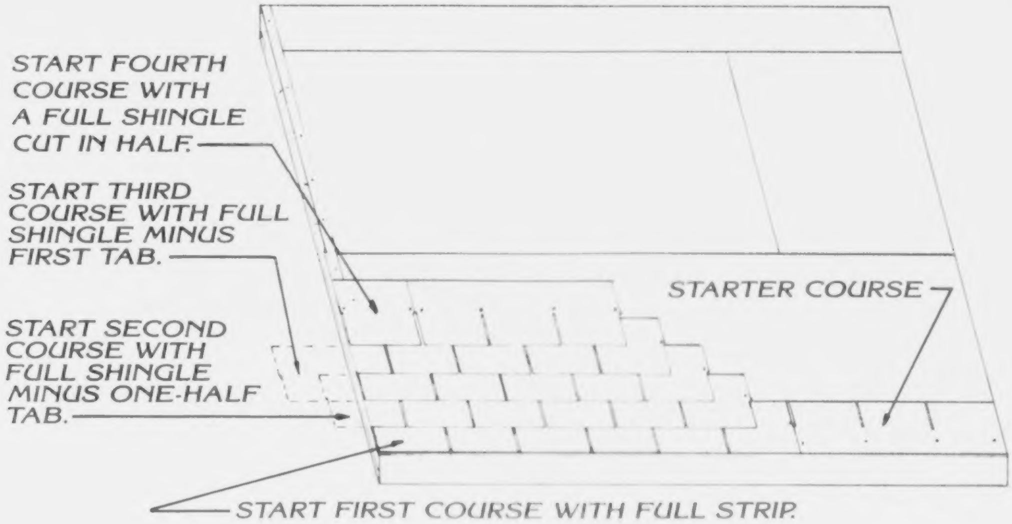
(NOTE: Cut 12 inches from the first shingle to eliminate first tab.)

E. Start fourth course with a full shingle cut in half, and apply all shingles so that lower edges of butts are aligned with top of cutouts of underlying course (See Figure 16)

INFORMATION SHEET

EXAMPLE:

FIGURE 16



START FOURTH COURSE WITH A FULL SHINGLE CUT IN HALF.
START THIRD COURSE WITH FULL SHINGLE MINUS FIRST TAB.
START SECOND COURSE WITH FULL SHINGLE MINUS ONE-HALF TAB.
STARTER COURSE
START FIRST COURSE WITH FULL STRIP.

XX. Steps for installing flashing at open-valley locations

(NOTE: Never walk in the valley.)

A. Center in valley an 18-inch-wide strip of mineral-surfaced asphalt roll roofing with mineral surface down

B. Cut lower edge of 18-inch roll roofing flush with eave flashing strip

(NOTE: When splicing any flashing material, the top piece should always overlap the lower piece 12 inches and should be secured with asphalt cement.)

C. Nail 18-inch roll roofing strip with just enough nails to hold it smoothly in place; nails should be 1 inch in from each edge of strip

(NOTE: Press flashing material firmly in place during nailing procedure.)

D. Center 36-inch-wide strip of mineral-surfaced asphalt roll roofing over the 18-inch-wide strip with mineral-surfaced side up

E. Secure 36-inch-wide strip with just enough nails to hold it smoothly in place; nails should be 1 inch from each edge of strip

(NOTE: Splicing procedures for 36-inch roll should be the same as for the 18-inch strip.)

INFORMATION SHEET

F. Mark center of valley at top and bottom; measure over 3 inches to each side of center line and mark

G. Snap a chalk line from top to bottom of valley

(NOTE: Chalk lines should be a minimum of 3 inches from the center of the valley along each of the intersecting roof areas. These parallel lines are the edge lines for the shingles of the intersecting roof lines.)

XXI. Estimating roofing materials needed for a three-tab asphalt-shingle roof

(NOTE: One square of strip shingles—enough to cover 100 square feet of roof—requires approximately seventy-six shingles. The actual number of shingles per square will vary slightly from manufacturer to manufacturer. The squares are sold by bundles, with three bundles per square.)

A. Calculate number of squares needed to cover roof surfaces

1. Measure length and width of each roof surface (Figure 17)

(NOTE: Measure valleys and hips at the halfway point. Where roof surfaces are symmetrical, measure one side and double measurement. See Figure 18.)

EXAMPLES:

FIGURE 17

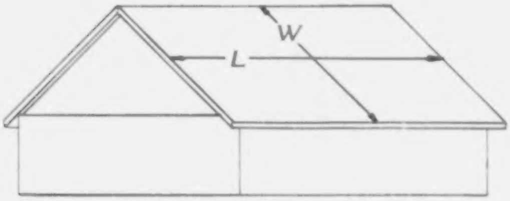
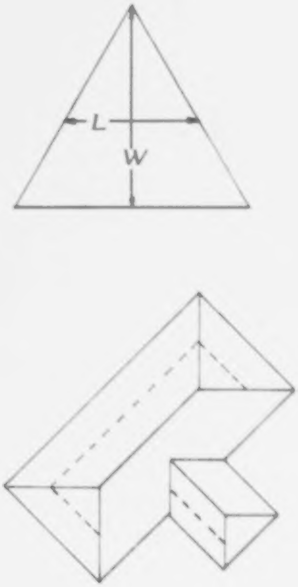


FIGURE 18



INFORMATION SHEET

2. Multiply length times width of each surface to find square footage of each roof surface

   EXAMPLE: If there are two 15′×30′ roof surfaces and two 12′×24′ roof surfaces, then

   15′×30′ = 450 sq ft
   15′×30′ = 450 sq ft
   12′×24′ = 288 sq ft
   12′×24′ = 288 sq ft

3. Add square footage of all roof surfaces to find total square footage of roof surface

   EXAMPLE: If there are two 450-square-foot roof surfaces and two 288-square-foot surfaces, then

   450 sq ft
   450 sq ft
   288 sq ft
   288 sq ft
   1,476 sq ft = total square footage

4. Measure length and width of each roof opening

5. Multiply length times width of each opening to find square footage of each opening

6. Subtract square footage of any opening larger than 30 square feet from total square footage of roof surface

7. Divide remaining total square footage by 100 to find number of squares of shingles needed to cover roof surfaces

   (NOTE: One hundred is the number of square feet of coverage per square of shingles.)

   EXAMPLE: If there are 1,476 square feet of roof, then

   1,476 ÷ 100 = 14.76 squares needed to cover roof surfaces

B. Calculate number of squares needed to cover ridge

   1. Measure each ridge

   2. Add all ridge measurements to find total lineal feet of ridge

INFORMATION SHEET

3. Divide total lineal feet of ridge by 25 to find number of bundles of shingles needed to cover ridge

   (NOTE: One bundle [one-third square] will cover approximately 25 lineal feet of ridge.)

   EXAMPLE: If there are 108 lineal feet of ridge with 5-inch exposure, then

   108 ÷ 25 = 4.32 bundles

4. Divide number of bundles by 3 to find number of squares needed to cover ridge

   (NOTE: There are three bundles in a square.)

   EXAMPLE: If there are 4.32 bundles, then

   4.32 bundles ÷ 3 = 1.44 squares needed to cover ridge

C. Calculate number of squares needed to cover double starter row

1. Measure number of lineal feet of eave
2. Multiply lineal feet of eave by 2 to allow for double row

   EXAMPLE: If there are 108 lineal feet of eave, then

   108 × 2 = 216 lineal feet of eave in double starter row

3. Divide lineal feet of eave by 3 to find number of shingles

   (NOTE: A standard strip shingle is approximately 3 feet long.)

   EXAMPLE: If there are 216 lineal feet of eave, then

   216 ÷ 3 = 72 shingles

4. Divide number of shingles by 76 to find number of squares

   EXAMPLE: If there are 72 shingles needed for eave, then

   72 ÷ 76 = 0.95 square needed to cover starter row

D. Calculate squares of waste — Multiply number of squares needed to cover surfaces times percentage of waste

(NOTE: Shape and design of roof determine amount of waste. The more valleys, chimneys, dormers, split levels, and so on, the higher the percentage of waste. Waste percentages usually range from 8 percent to 15 percent for material estimates.)

INFORMATION SHEET

E. Calculate total squares needed to cover roof — Add amounts determined in steps A through D and round up to next whole number if necessary

EXAMPLE: If 14.76 squares are needed to cover the roof surfaces, 1.44 squares are needed to cover the ridge, 0.95 square is needed to cover double starter row, and there are 1.48 squares of waste, then

Roof surfaces = 14.76 squares
Ridge = 1.44 squares
Double starter row = 0.95 squares
Waste = 1.48 squares

18.63 squares needed to cover roof

Order nineteen squares.

F. Calculate rolls of felt for underlayment — Divide number of squares of shingles needed to cover roof surfaces by 4 and round up to next whole number if necessary

(NOTE: Common felt used for underlayment is 15-pound asphalt-impregnated. The common size is 36 inches wide × 144 lineal feet long, or 4 squares per roll.)

EXAMPLE: If there are 14.76 squares needed to cover roof surfaces, then

$14.76 \div 4 = 3.69$ rolls of felt for underlayment

G. Check plans to determine amount of materials that will be needed for valleys, roof edging, and flashing as required by architectural design

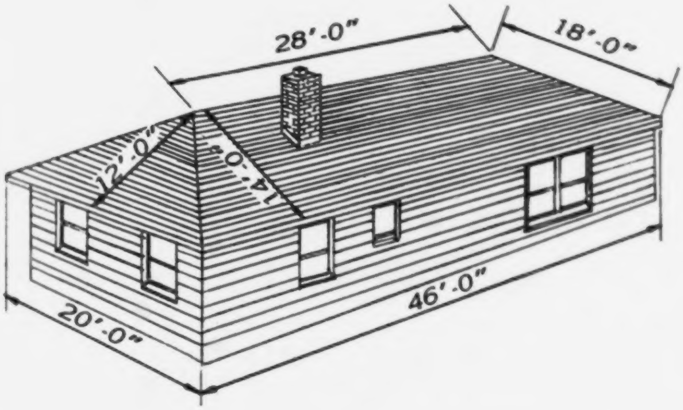
ROOF FINISHES
UNIT II

ASSIGNMENT SHEET #1 — ESTIMATE ROOFING MATERIALS

NAME ________________________________ SCORE ____________

Once the decking is on a roof, it is important to get the roofing on as quickly as possible to protect the decking and the framing members. For this reason, most builders like to have all roofing materials available at one time so that the job can be finished without delay. One delay that must be avoided is not having enough material to complete the job. Consequently, estimates for roofing materials must be accurate.

Study the illustration of the house below and estimate the materials that will be needed to cover the roof with three-tab asphalt shingles applied with 5-inch exposure. Write the correct answers in the blanks below. Show your work.



A. Squares needed to cover roof surface = ________________________

B. Squares needed to cover ridge = ________________________

C. Squares needed to cover double starter row = ________________________

D. Squares of waste = ________________________

E. Total squares that need to be ordered = ________________________

F. Rolls of underlayment that need to be ordered = ________________________

ROOF FINISHES
UNIT II

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

A. 12.76 squares

B. 1.33 squares

C. 1.15 squares

D. 1.27 squares

E. 17 squares

F. 4 rolls

ROOF FINISHES
UNIT II

JOB SHEET #1 — INSTALL AND THEN DISASSEMBLE ROOF BRACKETS AND SCAFFOLD PLANK

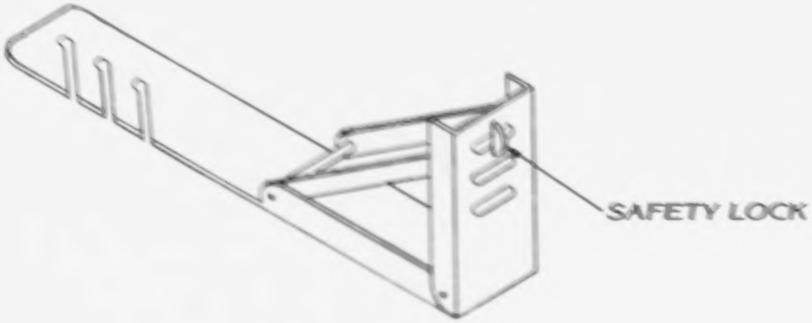
I. Tools and materials

- A. Two roof brackets
- B. 8-foot scaffold plank
- C. Wire or rope for tying off
- D. Hammer
- E. Hand line
- F. 16d nails

II. Procedure for installing roof brackets and scaffold plank

- A. Test scaffold plank on ground
- B. Carry or hoist brackets to roof
- C. Determine where brackets will be installed
- D. Place first bracket on roof and nail into place; be sure to nail through every holding slot on bracket and to check that nailheads are large enough so that they will not pull through slots
- E. Open bracket so that scaffold plank will be as level as possible; secure safety lock on bracket (Figure 19)

FIGURE 19



JOB SHEET #1

F. Place one end of plank over bracket so that approximately 6 inches of plank extend past bracket

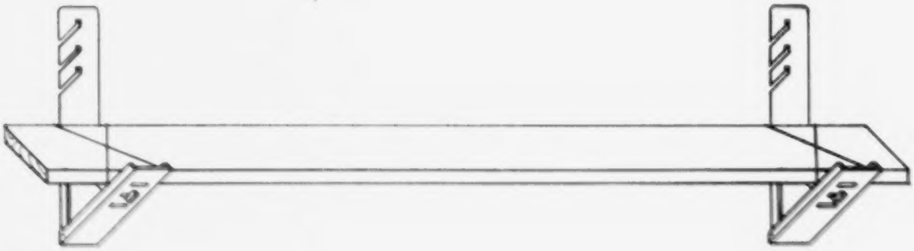
G. Lift other end of plank up until it is in proper position

H. Mark area where second bracket is to be installed (6 feet)

I. Open second bracket, place it in position level with first bracket, and nail in place, following procedure in steps D through F

J. Set scaffold plank on second bracket and secure plank to both brackets with rope or wire (Figure 20)

FIGURE 20



K. Check to see that scaffold is secure

L. Have instructor check your work

III. Procedure for disassembling roof brackets and scaffold plank

A. Untie wire or rope securing plank to brackets

B. Lower plank to ground

C. Push up on bottom of brackets and, if necessary, tap gently with a hammer to remove brackets

D. Lower brackets to ground

E. Drive nails that were used to secure brackets flush with roof surface

F. Clean up work area and put away tools and materials

ROOF FINISHES
UNIT II

JOB SHEET #2 — APPLY SATURATED-FELT UNDERLAYMENT AND ASPHALT SHINGLES WITH 5-INCH EXPOSURE

I. Tools and materials

- A. Roofer's hatchet
- B. Utility knife
- C. Margin trowel
- D. Plastic cement
- E. Prefabricated pipe flashing (single piece)
- F. Shingles and manufacturer's instructions
- G. Nails
- H. Metal drip edge
- I. Saturated-felt underlayment

II. Procedure for applying underlayment over sheathing (dry-in)

A. Apply full width of underlayment (3 feet) along eave, placing lower edge and end of underlayment flush with sheathing over eaves and rake

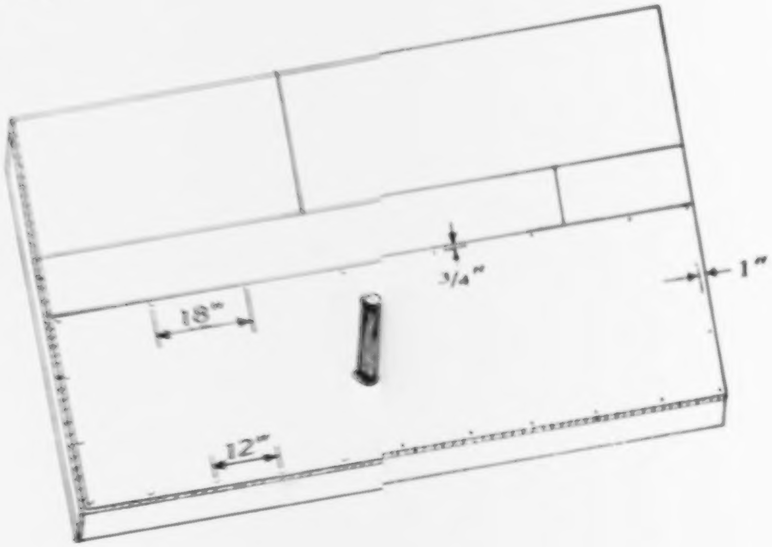
B. Nail underlayment 1/2 or 3/4 inch down and in a straight line from top edge of underlayment, spacing nails about 18 inches apart (See Figure 21)

(NOTE: This nailing pattern will secure the top edge of the underlayment until the next underlayment course is laid.)

C. Nail underlayment about 1 inch from edge of sheet along eaves and rake, spacing nails about 12 inches apart (Figure 21)

(NOTE: Lap underlayment 4 inches if splices are required.)

FIGURE 21

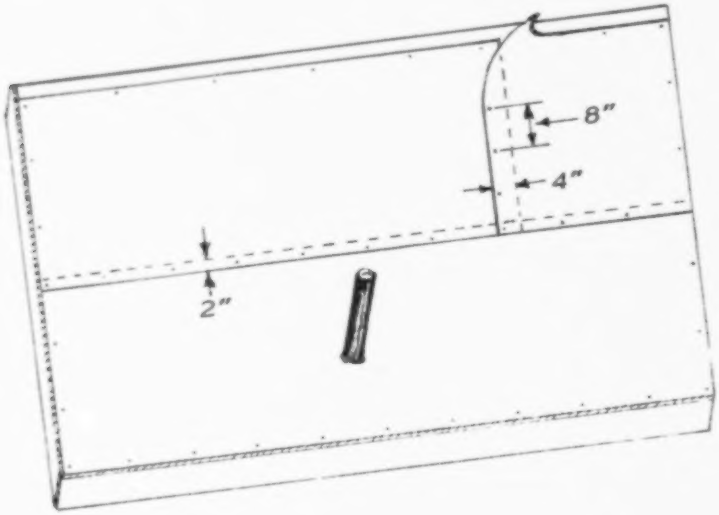


JOB SHEET #2

D. Apply second underlayment course, following procedures in steps B and C and lapping second course 2 inches down over first course (See Figure 22)

E. Continue applying underlayment, following procedures outlined in steps B and C and maintaining proper laps until entire roof is covered (Figure 22)

FIGURE 22



III. Procedure for applying shingles

A. Install metal drip edge

1. Put one nail about ½ inch in from center at each end of drip edge and another nail down about ¾ inches from top edge

2. Space nails about 10 inches apart down length of drip edge

B. Apply double starter course (See Figure 23)

1. Apply first row of double starter course so that top edge is down and even with edge of eave

2. Apply second row of double starter course so that it overlaps bottom edge of eave as recommended by manufacturer

C. Apply first course of shingles (See Figure 23)

1. Determine pattern to be used

EXAMPLES: One-half tab break, one-third tab break, 5-inch break

JOB SHEET #2

2. Follow manufacturer's recommendations for layout and installation

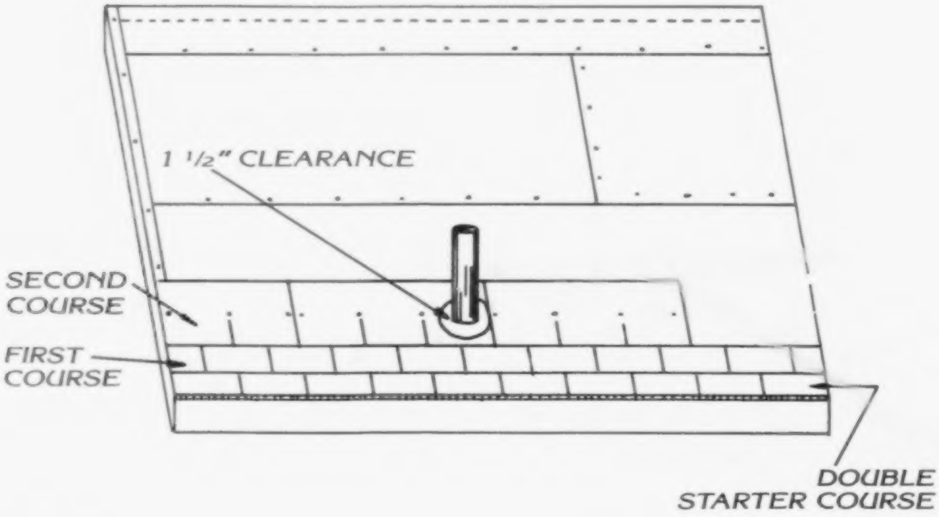
   (NOTE: Often manufacturers will give installation instructions on the package. These instructions should be followed exactly. Use the recommended nailing pattern, checking to see whether or not different nailing patterns are required for different pitches. Also, manufacturers may specify a gap between abuting edges of shingles or other procedures.)

D. Apply second course of shingles, following procedure determined for first course until you get to vent pipe

E. Make cutout for vent pipe and install flashing

1. Cut and fit shingle around vent pipe, allowing about 1½-inch clearance (Figure 23)

FIGURE 23

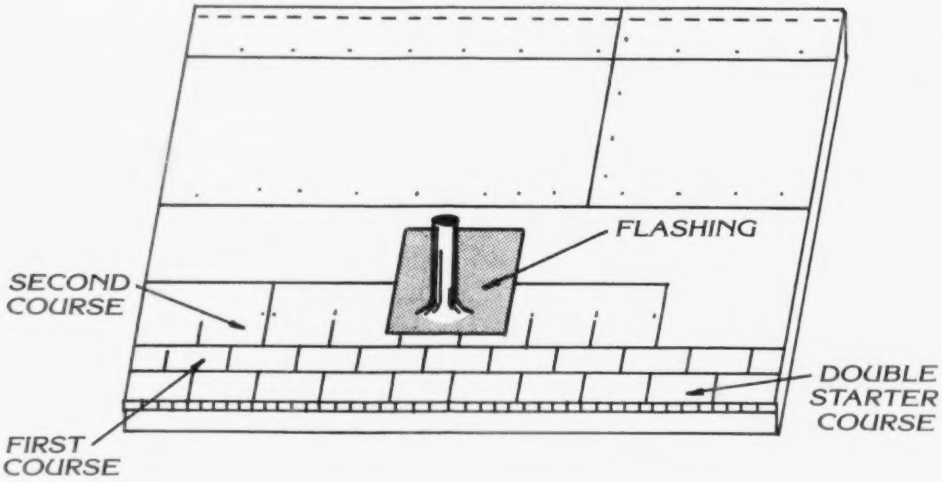


2. Apply shingle and nail in place (See Figure 23)

3. Slide flashing over pipe so that it fits firmly, with top edge of flashing flange resting on underlayment and bottom edge of flashing flange resting over second course of shingles (See Figure 24)

JOB SHEET #2

FIGURE 24



F. Finish second course of shingles

G. Apply third course of shingles, following procedure determined for first course until you get to vent pipe

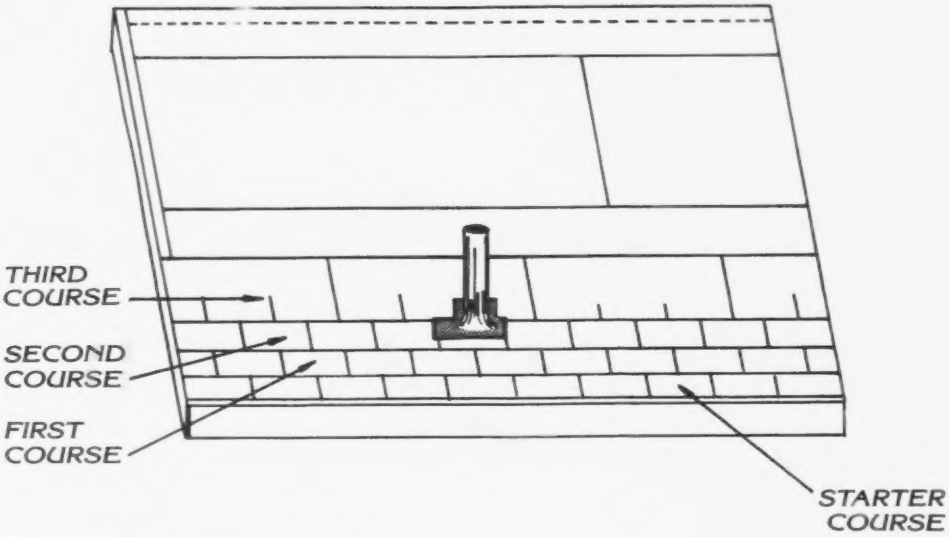
(NOTE: While you are fitting shingles around vent pipe, another person may continue applying shingles by stair-stepping them up the roof's edge. See Figure 25.)

H. Make cutout for vent pipe by cutting and trimming shingle so that it fits around vent pipe and is in proper alignment with other shingles (See Figure 25)

(NOTE: When nailing the shingle around the vent pipe, do not nail within 6 inches of the vent pipe.)

JOB SHEET #2

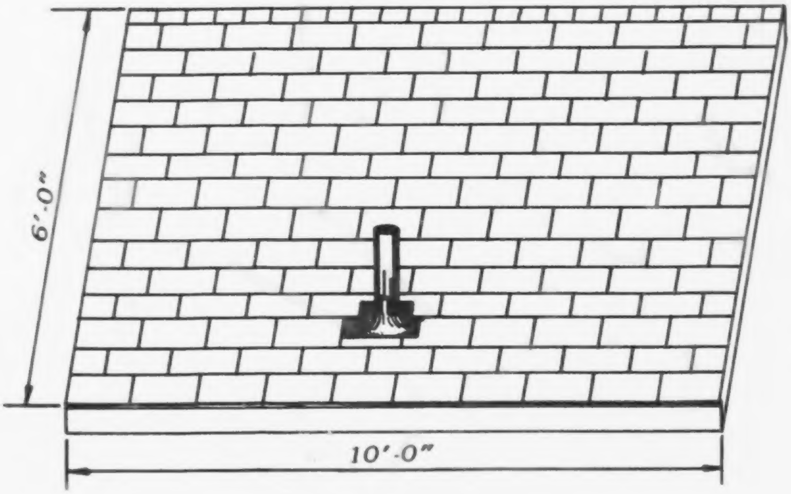
FIGURE 25


THIRD COURSE
SECOND COURSE
FIRST COURSE
STARTER COURSE

I. Finish third course of shingles

J. Continue applying courses, including ridge shingles, until project is completed (Figure 26)

FIGURE 26



JOB SHEET #2

K. Have instructor check your project

L. Clean area and put away tools and materials

ROOF FINISHES
UNIT II

JOB SHEET #3 — APPLY WOOD SHINGLES WITH 5-INCH EXPOSURE OVER SPACED SHEATHING

I. Tools and materials

   A. Roofer's hatchet

   B. Utility knife

   C. Metal drip edge

   D. Wood shingles and manufacturer's instructions

   E. Nails

II. Procedure

   A. Install metal drip edge

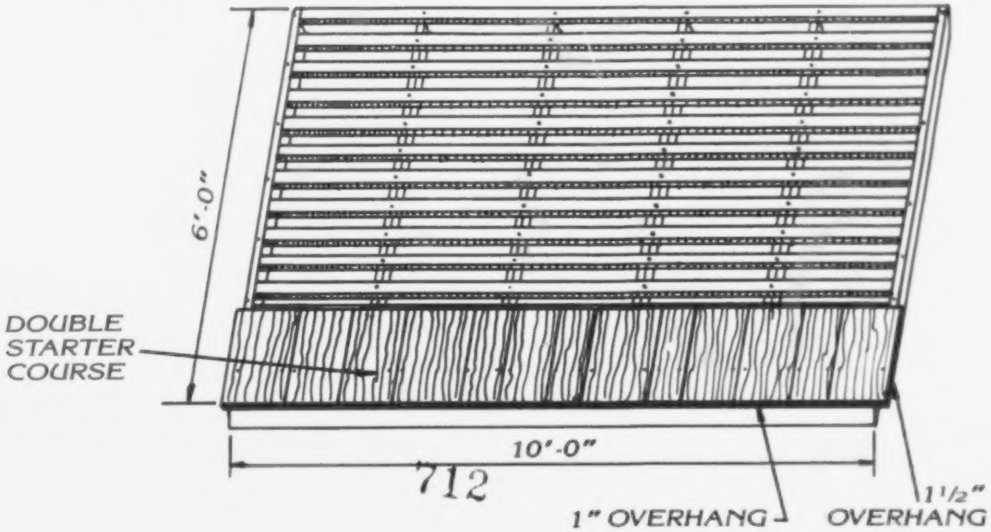
      1. Put one nail about 1/2 inch in from center at each end of drip edge and another nail down about 3/4 inch from top edge

      2. Nail remainder of drip edge down, spacing nails about 10 inches apart down length of drip edge

   B. Apply double starter course

      1. Apply first row of double starter course, allowing 1-inch overhang at eave and leaving 1/4 to 3/8 inch between edges of shingles (Figure 27)

FIGURE 27



JOB SHEET #3

2. Nail each shingle, using two nails and spacing nails in from edge of shingle 3/4 inch and about 1 1/2 inches above butt line of next course

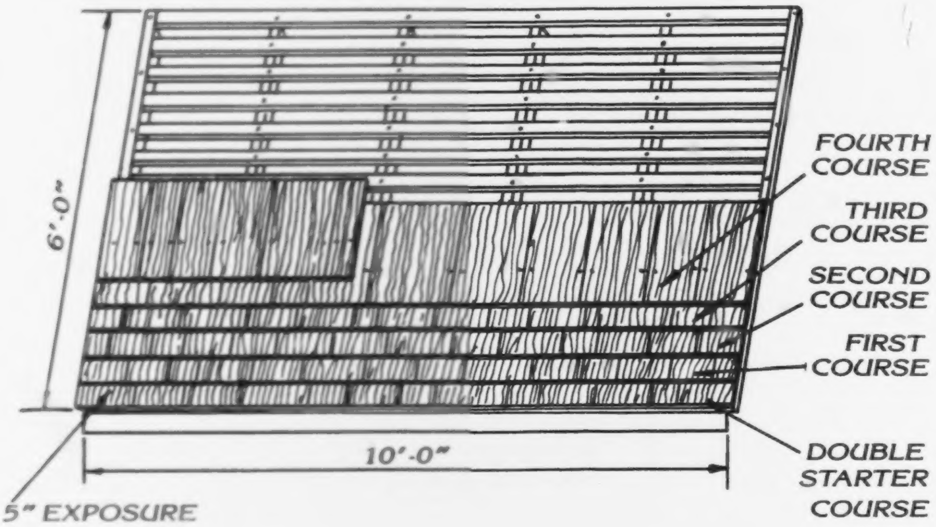
   (NOTE: Drive nails flush with shingle surface. Do not damage surface of shingle around nail.)

3. Apply second row of double starter course over first row, spacing shingles so that joints in second row are offset at least 1 1/2 inches from joints in first row

C. Apply first course of shingles, allowing for 5-inch exposure and leaving 1/4 to 3/8 inch between edges of shingles (See Figure 28)

D. Continue applying courses, following procedure in step C until job is complete (Figures 28 and 29)

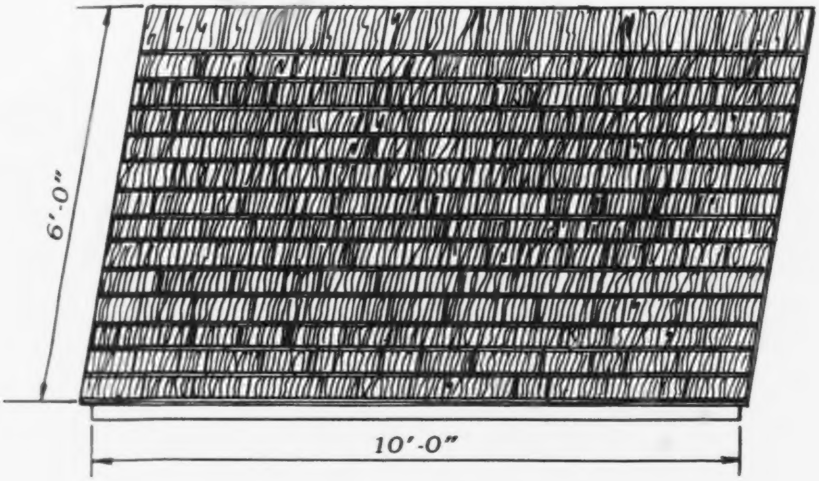
FIGURE 28



6'-0"
FOURTH COURSE
THIRD COURSE
SECOND COURSE
FIRST COURSE
DOUBLE STARTER COURSE
10'-0"
5" EXPOSURE

JOB SHEET #3

FIGURE 29



E. Have instructor check your project

F. Clean up area and put away tools and materials

ROOF FINISHES
UNIT II

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with roofing to their correct definitions. Write the correct numbers in the blanks.

______a. Rock granules that cover asphalt-coated composition roofing

______b. Slot or opening in tab shingle

______c. Incline of roof as a ratio of vertical rise to horizontal run

______d. Bottom edge of shingle

______e. Shingles split from logs and shaped for commercial use

______f. Roof with several layers of felt or jute that are saturated with coal tar, pitch, or asphalt with a topping of aggregate

______g. Brace that supports scaffold plank between two ladders

______h. Roof with ridge at center and double slope on each of its two sides

______i. 1×4 boards that are nailed to rafters with spacings equal to width of boards

______j. Edge of roof from which water drips into gutter or into the open

______k. Material made of copper-bearing steel that has been heat-treated to provide best balance between malleability and toughness

______l. Portion of shingle that is subjected to weathering

______m. Brace that is used on roof to support scaffold planks, which are used as a work platform

______n. Amount of roofing material needed to provide 100 square feet of finished roofing

______o. Material (usually sheet metal) used to prevent rain or other moisture from entering structure

1. Slope
2. Spaced deck sheathing
3. Built-up roof
4. Terne metal
5. Cutout (water channel)
6. Drip edge
7. Curb roof
8. Roof bracket
9. Wood shakes
10. Mineral surface
11. Exposure
12. Flashing
13. Ladder jack
14. Butt edge
15. Square

TEST

2. State safety rules pertaining to roofing.

Appropriate dress (List two safety rules.)

a. ______________________________

b. ______________________________

Ladder safety (List three safety rules.)

a. ______________________________

b. ______________________________

c. ______________________________

Scaffold safety (List three safety rules.)

a. ______________________________

b. ______________________________

c. ______________________________

Tools and materials (List four safety rules.)

a. ______________________________

b. ______________________________

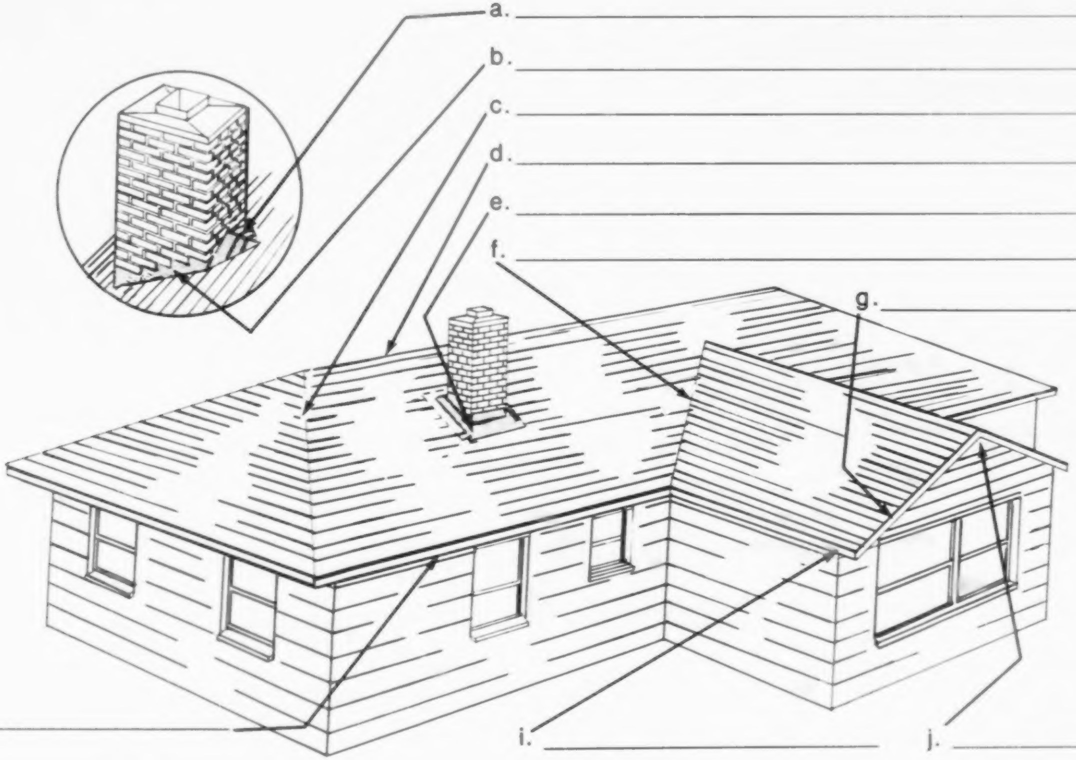
c. ______________________________

d. ______________________________

TEST

3. Identify the parts of the roof illustrated below. Write the correct names in the blanks.

Fascia
Valley
Eave
Step flashing
Saddle (cricket)
Flashing
Gable
Ridge
Rake
Hip



a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

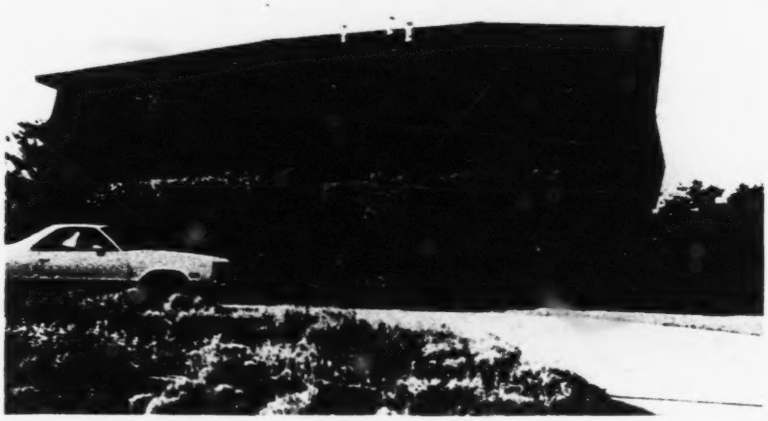
i. ______________________________

j. ______________________________

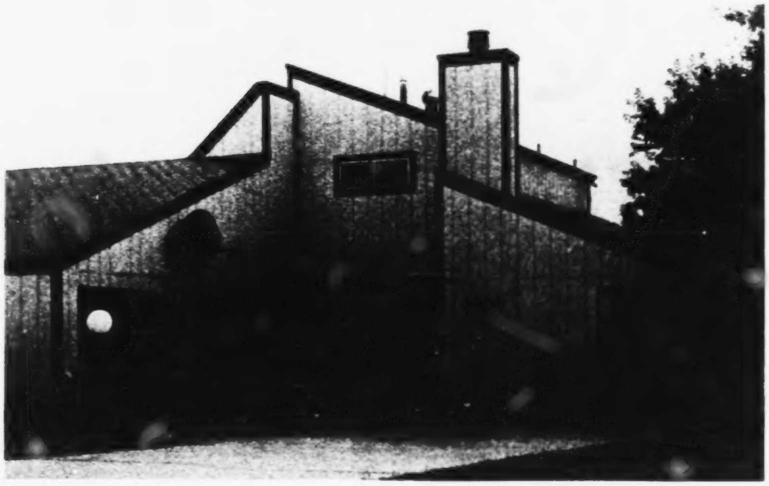
TEST

4. Identify the traditional residential roof designs in the photographs below and on the following pages. Write the correct names in the blanks.

Gambrel
Flat
Mansard
Monopitched
Gable
Hip



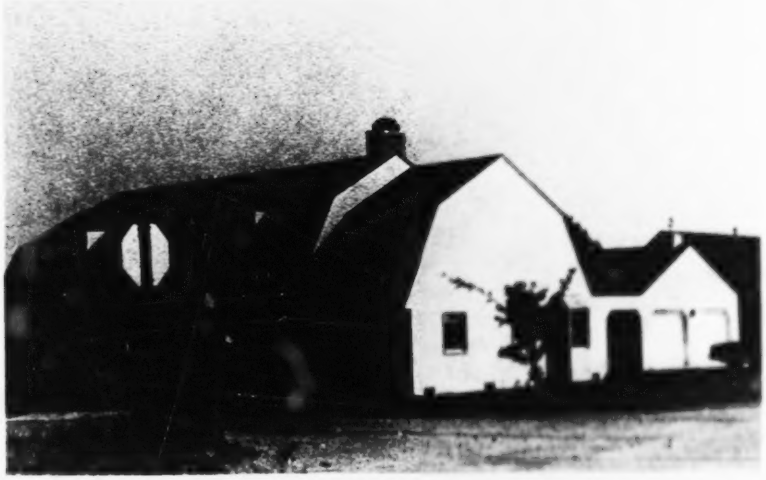
a. ______________________________



b. ______________________________

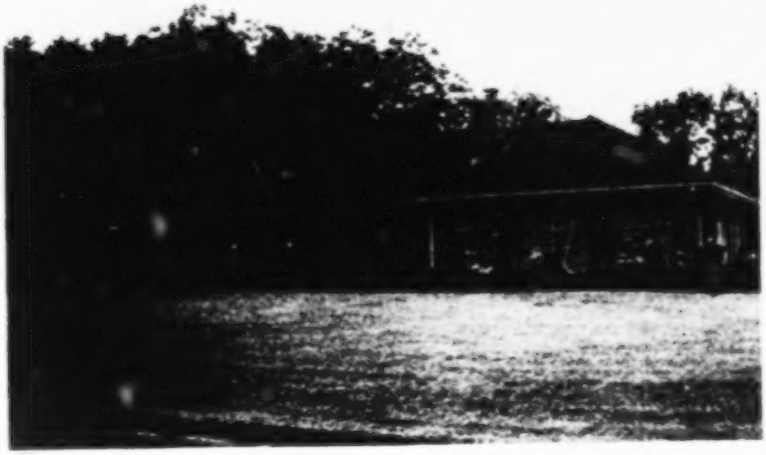
TEST

c. ______________________________

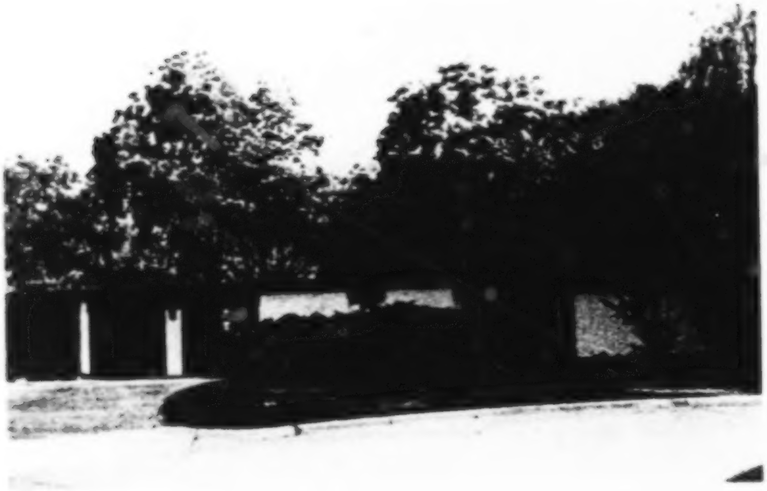


d. ______________________________

TEST



e. ______________________________



f. ______________________________

TEST

5. Name four classes of roofing.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

6. Match minimum slope requirements to their specific roofing applications. Write the correct numbers in the blanks.

_____a. Use roll roofing with exposed nails

_____b. Use any style of shingle roofing

_____c. Use built-up roofing

_____d. Use roll roofing with concealed nails or double-coverage roll roofing

1. From 3½ in 12 to vertical
2. From 1 to 2 in 12
3. From 2 to 3 in 12
4. From flat to 1 in 12

7. List six types of roofing materials.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

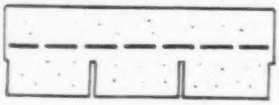
e. ______________________________

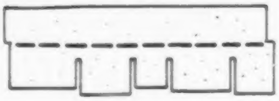
f. ______________________________

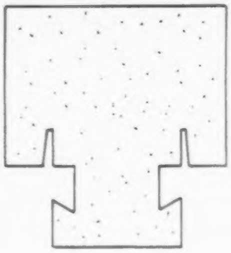
TEST

8. Identify basic types of asphalt shingles. Write the correct names in the blanks.

Wood-appearance strip shingle with single thickness per strip
Wood-appearance strip shingle with more than one thickness per strip
Strip shingle without tabs
Individual lockdown shingle
Strip shingle with tabs



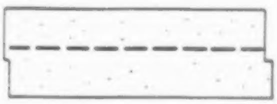


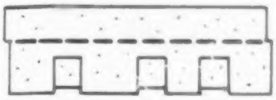


a. ______________________
____

b. ______________________
____

c. ______________________
____





d. ______________________
____

e. ______________________
____

9. Distinguish between the definitions of wood shingles and wood shakes. Write an "X" in the blank before the definition of wood shakes.

_____a. Wood roofing products that are sawed in 16-, 18-, and 24-inch lengths and in uniform butt thicknesses per individual length

_____b. Wood roofing products that are split from logs and roughly sawed in lengths and in various butt thicknesses per individual length

TEST

10. State decking requirements for applying wood shingles and wood shakes. Write in the missing words to complete the following statements.

Spaced decking

a. Use __________ sheathing boards

b. Space sheathing boards with no more distance between centers than maximum recommended __________ __________ for shingle

c. Use __________-type building paper if underlayment is required

Solid decking — Use a minimum of __________ plywood decking

11. State guidelines for applying wood shingles. Write in the missing words to complete the following statements.

a. __________ shingles at eaves and __________ shingles at joints

b. Extend first and starter courses a minimum of __________ beyond finished fascia board or last sheathing board and __________ at gable ends

c. Install shingles so that space between adjacent shingles (joints or slots) is no less than __________ and no more than __________

d. Stagger joints in one course at least __________ from joints in adjacent course

e. Drive one nail no more than __________ from each side of shingle and no more than __________ above shingle's exposure line

f. Drive each nail so that head is __________ with shingle surface; *do not* drive __________ into wood fiber

TEST

g. Cover hips and ridges with shingles that have a uniform width of ____________ to ____________.

h. Attach hip and ridge shingles with alternate overlaps and with an exposure ____________ to that of all preceding courses

12. State guidelines for applying wood shakes. Write in the missing words to complete the following statements.

a. Apply ____________ layer of shakes at eaves and ____________ shakes at joints

b. Use ____________ or ____________ wood shingles for starter course

c. Extend starter course a minimum of ____________ beyond finished fascia board or last sheathing board

d. Apply a ____________-inch, ____________-pound roofing felt at eave lines

e. Lay an ____________-inch strip of ____________-pound felt over top portion of each previously applied course of shakes, and be sure it extends onto the sheathing

f. Apply felt so that bottom edge is equal to ____________ the distance of exposure

g. Space shakes so that joint between each shake is ____________ and so that joint between adjacent courses is offset a minimum of ____________

h. Allow ____________ overhang at gable ends

TEST

i. Drive one nail no more than ______________ from each side of shake and about ______________ above butt line of following course

j. Drive each nail so that head is ______________ with the shake surface; *do not* drive ______________ into wood fiber

k. Cover hip and ridges with shakes having a uniform width of ______________ to ______________

l. Attach hip and ridge shakes with alternate overlaps and with an exposure ______________ to that of all preceding courses

13. List guidelines for applying underlayment.

a. ____

b. ____

c. ____

14. Describe general requirements for applying flashing.

a. ____

____

____

b. ____

____

____

c. ____

____

____

TEST

15. Select from the following list areas where flashing should be used. Write an "X" in the blank before each correct answer.

_____a. Vent stacks

_____b. Ridge

_____c. Skylights

_____d. Chimneys

_____e. Saddle edges

_____f. Hips

_____g. Valleys

_____h. Rake

_____i. Hip and ridge junctions

_____j. Roof vents

_____k. Vertical walls

16. Select from the following list types of materials used for flashing. Write an "X" in the blank before each correct answer.

_____a. Built-up roofing

_____b. Lead

_____c. Polyurethane

_____d. Copper

_____e. Aluminum

_____f. Corrugated metal

_____g. Roll roofing (50- to 90-pound mineral-surfaced asphalt)

_____h. Galvanized metal

_____i. Tin-coated metal

TEST

17. Match roofing equipment and tools to their correct uses. Write the correct numbers in the blanks.

______a. Used to measure, check dimensions, and lay out work

______b. Used to cut flashing materials

______c. Used to cut felt, insulation, shingles, and roll roofing

______d. Used to mark lines and dimensions, to make marks indicating leaks or other defects, and to write special instructions

______e. Used to nail and cut shingles

______f. Used to move material from ground or truck to roof, or from one location to another

______g. Used in pairs to form a working platform for loading material and a staging point for application procedures; also used as a safety barricade for tools or material that may fall from roof

______h. Used to power-attach fasteners

______i. Used as a safety device on steep roofs

______j. Used to provide access to or exit from roof; also used in pairs to support ladder jacks and scaffold planks

______k. Used to lay out work

______l. Used to hold hand tools and fasteners

______m. Used in pairs to provide workers with a safe work area and a place to hold materials

______n. Used to apply mastic

1. Hoisting equipment
2. Steel tape
3. Roof brackets and scaffold plank
4. Chalk line
5. Safety line
6. Hatchet
7. Pointing trowel or margin trowel
8. Ladder jacks and scaffold plank
9. Combination tin snips
10. Keel (marking crayon)
11. Tool belt and nail bag
12. Nailer or stapler
13. Extension ladder
14. Utility knife

18. Select from the following list guidelines for applying double starter course of asphalt shingles. Write an "X" in the blank before each correct answer.

______a. Fasten double starter course with roofing nails along a line that is parallel to and 3 to 4 inches above edge of eave

TEST

_____b. Space nails so that nailheads will not be exposed after first course of shingles is applied

_____c. Leave 1/2- to 3/4-inch space between shingles

_____d. Apply first row of asphalt shingles or 9-inch (or wider) strip of mineral-surfaced asphalt roll roofing along eave of roof

_____e. Secure metal drip edge over starter course

_____f. Apply second row of shingles so that it overlaps bottom edge of eave as recommended by manufacturer

19. State guidelines for applying shingles with cutouts that break joint in half. Write in the missing words to complete the following statements.

a. Nail each shingle with four nails: one ____________ above each cutout and one at each end approximately ____________ in from edge of shingle

b. Start first course with a ____________ ____________, and apply all shingles so that lower edges of butts are ____________ with bottom edge of starter course

c. Start second course with a full shingle minus ____________ ____________, and apply all shingles so that lower edges of butts are ____________ with top of cutouts of underlying course

d. Start third course with a full shingle minus ____________ ____________, and apply all shingles so that lower edges of butts are ____________ with top of cutouts of underlying course

e. Start fourth course with a full shingle cut ____________ ____________, and apply all shingles so that lower edges of butts are ____________ with top of cutouts of underlying course

TEST

20. Arrange in order the steps for installing flashing at open-valley locations. Write a "1" in the blank before the first step, a "2" before the second step, and so on.

    ______a. Nail 18-inch roll roofing strip with just enough nails to hold it smoothly in place; nails should be 1 inch in from each edge of strip

    ______b. Mark center of valley at top and bottom; measure over 3 inches to each side of center line and mark

    ______c. Center in valley an 18-inch-wide strip of mineral-surfaced asphalt roll roofing with mineral surface down

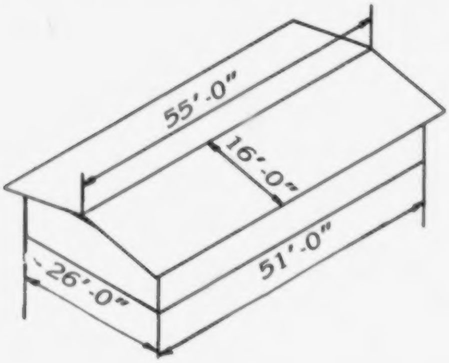
    ______d. Secure 36-inch-wide strip with just enough nails to hold it smoothly in place; nails should be 1 inch from each edge of strip

    ______e. Snap a chalk line from top to bottom of valley

    ______f. Center 36-inch-wide strip of mineral-surfaced asphalt roll roofing over the 18-inch-wide strip with mineral-surfaced side up

    ______g. Cut lower edge of 18-inch roll roofing flush with eave flashing strip

21. Estimate roofing materials needed for the three-tab asphalt-shingle roof illustrated below. Write the correct answers in the blanks. Show your work.



a. Squares needed for roof surface = ______________________________

b. Squares needed for ridge = ______________________________

c. Squares needed for double starter row = ______________________________

d. Squares of waste = ______________________________

e. Total squares that need to be ordered = ______________________________

f. Rolls of underlayment that need to be ordered = ______________________________

TEST

(NOTE: Test question 22 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

22. Demonstrate the ability to

    a. Install and then disassemble roof brackets and scaffold plank.

    b. Apply asphalt shingles with 5-inch exposure.

    c. Apply wood shingles with 5-inch exposure over spaced sheathing.

ROOF FINISHES
UNIT II

ANSWERS TO TEST

1. a. 10
   b. 5
   c. 1
   d. 14
   e. 9
   f. 3
   g. 13
   h. 7
   i. 2
   j. 6
   k. 4
   l. 11
   m. 8
   n. 15
   o. 12

2. **Appropriate dress** (Answer should include any two of the following)

   a. Wear goggles
   b. Wear hard hats as required
   c. Wear ankle-high work shoes with nonskid soles
   d. Wear gloves as required
   e. Wear protection against the elements

   Ladder safety (Answer should include any three of the following)

   a. Inspect ladders before they are sent to job site
   b. Select the right ladder for the job
   c. Tie off ladders at top
   d. Be sure all ladders are equipped with safety shoes
   e. Secure ladders at bottom if they extend more than 3 feet above roof line

   Scaffold safety (Answer should include any three of the following)

   a. Test scaffold planks before sending them to job site
   b. Be sure scaffold planks are properly secured to properly attached roof brackets
   c. Always use nails through *all* holding slots on roof brackets
   d. Nail roof brackets into rafters whenever possible
   e. Secure scaffold planks to ladder jacks with rope or heavy-gauge wire

   Tools and materials (Answer should include any four of the following)

   a. Stay within load limits of equipment being used
   b. *Do not* let anyone walk under load that is being hoisted
   c. Never overload one section of roof with materials; distribute materials evenly over entire roof area
   d. Lift heavy materials correctly
   e. Never carry utility knife in your pocket; keep knife in its holster
   f. Handle hatchets carefully
   g. Do not use power fasteners until you have read manufacturer's instructions and passed safety test

3. a. Saddle (cricket)
   b. Step flashing
   c. Hip
   d. Ridge
   e. Flashing
   f. Valley
   g. Rake
   h. Eave
   i. Fascia
   j. Gable

ANSWERS TO TEST

4. a. Mansard
   b. Monopitched
   c. Gable
   d. Gambrel
   e. Hip
   f. Flat

5. Answer should include any four of the following

   a. Shingle roofing
   b. Roll roofing
   c. Tile roofing
   d. Built-up roofing
   e. Metal roofing
   f. Formed-glass roofing
   g. Polyurethane-foam roofing

6. a. 3
   b. 1
   c. 4
   d. 2

7. Answer should include any six of the following

   a. Wood
   b. Asphalt
   c. Rosin sheathing
   d. Mineral fiber
   e. Hot asphalt, coal tar, pitch, and aggregate
   f. Fiberglass
   g. Nonreinforced plastic
   h. Vinyl
   i. Structural glass
   j. Porcelain
   k. Clay
   l. Slate
   m. Concrete
   n. Stainless steel
   o. Zinc alloy
   p. Titanium-copper
   q. Tin
   r. Lead
   s. Galvanized iron
   t. Terne metal
   u. Copper

8. a. Strip shingle with tabs
   b. Wood-appearance strip shingle with single thickness per strip
   c. Individual lockdown shingle
   d. Strip shingle without tabs
   e. Wood-appearance strip shingle with more than one thickness per strip

9. b

10. **Spaced decking**

    a. 1×4
    b. Weather exposure
    c. Breather

    Solid decking — ½-inch

ANSWERS TO TEST

11. a. Double; stagger
    b. 1½ inches; 1 inch
    c. ¼ inch; ⅜ inch
    d. 1½ inches
    e. ¾ inch; 1½ inches
    f. Flush; head
    g. 3 inches; 5 inches
    h. Equal

12. a. Double; stagger
    b. 15-inch; 18-inch
    c. 1½ inches
    d. 36; 30
    e. 18; 30
    f. Twice
    g. ½ inch; 1½ inches
    h. 2-inch
    i. 1 inch; 2 inches
    j. Flush; head
    k. 4 inches; 6 inches
    l. Equal

13. a. Lap top of underlayment at least 2 inches
    b. Lap sides and ends of underlayment at least 4 inches
    c. Lap each side of center line at least 6 inches on hips and valleys

14. Description should include the following

    a. Apply valley and edge flashing before applying shingles
    b. Apply flashing at all intersections of different roof planes, all abutments of roof against adjoining walls, and all projections through roof surface
    c. Apply flashing so that descending water will be carried over a joint, *not into it*

15. a, c, d, g, j, k

16. b, d, e, g, h, i

17. a. 2
    b. 9
    c. 14
    d. 10
    e. 6
    f. 1
    g. 8
    h. 12
    i. 5
    j. 13
    k. 4
    l. 11
    m. 3
    n. 7

18. a, b, d, f

ANSWERS TO TEST

19. a. 3/4 inch; 3/4 inch
    b. Full shingle; aligned
    c. One-half tab; aligned
    d. First tab; aligned
    e. In half; aligned

20. a. 3
    b. 6
    c. 1
    d. 5
    e. 7
    f. 4
    g. 2

21. a. 17.60 squares
    b. 1 square
    c. 1 square
    d. 1.76 squares
    e. 21.36 squares
    f. 5 rolls

22. Performance skills evaluated to the satisfaction of the instructor

EXTERIOR WALLS AND TRIM
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to identify and install different types of wall sheathing and siding. The student will show this knowledge by completing the assignment sheets, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with exterior wall finishes and trim.
2. Name types of wall sheathing.
3. Match types of wall coverings to their correct categories.
4. Identify styles of siding.
5. Identify joint details for plywood siding.
6. Identify types of exterior moldings and trims.
7. List recommendations for waterproofing exterior walls.
8. Estimate amounts of siding for given jobs.
9. Demonstrate the ability to
    a. Install sheathing.
    b. Install bevel siding.
    c. Install sheathing and plywood siding.

EXTERIOR WALLS AND TRIM
UNIT III

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Supplements

      1. Supplement #1 — Surface Textures and Designs of Siding

      2. Supplement #2 — Fasteners, Hardware, and Accessories Used with Siding

   D. Transparency masters

      1. TM #1 — Types of Sheathing

      2. TM #2 — Types of Bracing

      3. TM #3 — Types of Siding

   E. Information sheet

   F. Assignment sheets

      1. Assignment Sheet #1 — Estimate Siding for a House with a Gable Roof

      2. Assignment Sheet #2 — Estimate Sheathing and Siding for a House with a Hip Roof

   G. Answers to assignment sheets

   H. Job sheets

      1. Job Sheet #1 — Install Sheathing

      2. Job Sheet #2 — Install Bevel Siding

      3. Job Sheet #3 — Install Sheathing and Plywood Siding

   I. Test

   J. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

   B. Obtain materials to supplement unit.

SUGGESTED ACTIVITIES

C. Obtain transparencies and competency profiles.

(NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

D. Introduce unit.

SUGGESTIONS:

- Show the students various types of sidings.
- Display photographs or drawings of houses with a variety of applications of various sidings; if possible, present elevations of a house with different sidings or installation patterns.

  (NOTE: Often houses with the same floor plan in a tract development will be finished differently. Also, remodelers and their suppliers may have before-and-after pictures of houses on which the siding has been redone.)

E. Provide students with objective sheet.

F. Discuss unit and specific objectives, relating them to your introduction of the unit.

G. Provide students with information sheet.

H. Discuss information sheet.

1. Use Information Sheet, Section I to discuss terms associated with exterior walls.

   SUGGESTIONS:

   - Provide samples of the types of materials described.
   - Clarify which materials are sheathing, which are siding, and which may be either.

2. Use Information Sheet, Section II and Transparencies #1 and #2 to discuss types of sheathing, emphasizing the materials and methods used in your area.

   SUGGESTIONS:

   - Discuss bracing requirements for each type of sheathing, emphasizing local regulations.

SUGGESTED ACTIVITIES

- Provide students with samples of various types of sheathing; discuss the properties of each (ease of application, durability, thermal insulation value, etc.) or have a manufacturer's representative or distributor discuss the properties.

- Provide students with examples of hardware and fasteners used with each type of siding, and hand out copies of Supplement #2.

- Demonstrate the application of various types of sheathing and allow students to practice nailing and cutting sheathing in the shop.

- Demonstrate Job Sheet #1 and allow students to practice procedures; discuss different techniques and preferences.

3. Use Information Sheet, Section III to discuss categories of wall coverings.

SUGGESTIONS:

- Provide students with samples of each type and discuss their applications.

- Invite a panel of distributors and installers to discuss the advantages and disadvantages of the various types of sidings.

- List other types of wall coverings commonly used in your area.

- Invite an architect to talk to the class about design considerations in sidings, emphasizing the different effects that can be achieved with different applications and with various combinations of exterior finishes.

- Discuss the use of sheathing and situations when sheathing is not used for each type of wall covering.

- Discuss the steps in applying siding (such as finishing gables first), and relate them to the total construction process; emphasize considerations for other workers such as electricians, plumbers, and masons.

- Demonstrate the installation of various types of siding and allow students to practice; refer to hardware and accessories covered in Supplement #2.

4. Use Information Sheet, Section IV to discuss styles of siding.

SUGGESTIONS:

- Provide class with samples of each siding type in various materials; discuss the types of wood used for the various styles, emphasizing those common in your area.

SUGGESTED ACTIVITIES

- Give students copies of Supplement #1, or use samples of the various textures of hardboard and plywood sidings, to discuss designs and applications; invite a manufacturer's representative or distributor to discuss the topic.

- Tour a lumber mill or manufacturing plant to see siding being produced.

- Demonstrate Job Sheet #2 and allow students to practice procedures; discuss details of installation at corners, grades, and surface changes.

5. Use Information Sheet, Section V to discuss joint details for plywood and hardboard sidings.

   SUGGESTIONS:

   - Review joints outlined in information sheet and discuss others, emphasizing those suitable for horizontal and vertical joints.

   - Relate joint details to specific materials and applications.

   - Discuss nailing and caulking requirements.

   - Demonstrate requirements for transitions between materials, such as a change from lap siding on the walls to board and batten on the gable.

6. Use Information Sheet, Section VI to discuss exterior molding and trim.

   SUGGESTIONS:

   - Provide students with samples of trim, and discuss their applications.

   - Demonstrate mitering and coping.

   - Tour construction sites to see the various types of trim being used; relate the trims to exterior finishes, emphasizing those that are optional and those that are mandatory for specific applications.

7. Use Information Sheet, Section VII to discuss waterproofing exterior walls.

   SUGGESTIONS:

   - Demonstrate and discuss the swelling and contraction of sidings; invite a paint or stain manufacturer or distributor to talk to the class about proper sealing of sidings, emphasizing wood preservatives, primers, sealants, and caulking compounds.

SUGGESTED ACTIVITIES

- Provide class with samples of various types of flashings, emphasizing those used with sidings.

- Show the class examples of hardboard and other sidings that were exposed to weather without being adequately protected.

  (NOTE: Such material may be stained, moldy, delaminated, cracked, or warped. Hardboard may actually crumble in your hand. Most lumberyards will have samples of such materials.)

- Discuss layout and installation techniques that will help weatherproof walls; demonstrate Job Sheet #3 and allow students to practice.

8. Use Information Sheet, Section VIII to discuss how to estimate materials for exterior walls.

   (NOTE: Throughout the course, additional considerations are being added in the estimating of materials. In previous units, the emphasis has been on material required for the job. In this unit, the students are taught to allow for waste. Relate this concept to previous estimating procedures. You may want to consider having the students do a package estimate from blueprints for all materials covered up to this point.)

   SUGGESTIONS:

   - Demonstrate estimating procedures, and discuss variations in techniques; note that a number of examples are given and use these in your discussion.

   - Use Assignment Sheets #1 and #2 to allow student practice of the procedures.

   - Provide students with plans so that they can compute allowances for openings and be exposed to features that affect siding estimates; specify a variety of finishes and application if not given in the plans so that the students will have to estimate a number of different materials with broken areas of applications.

   - Have students use a house plan to compute materials costs for various materials commonly used and available in your area.

I. Review unit.

J. Give test.

K. Critique test and discuss in class.

L. Reteach and retest as necessary.

SUGGESTED ACTIVITIES

M. Complete appropriate section of competency profiles.

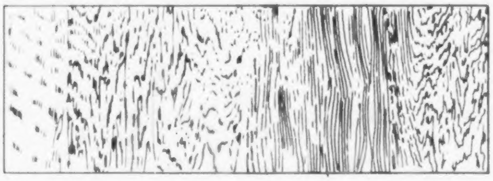
III. Unit references

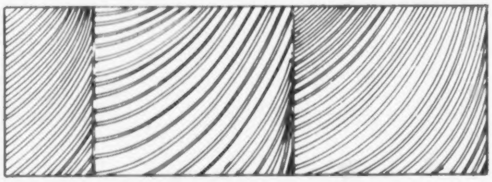
A. Hendrix, Laborn J. "Bud." *Commercial Carpentry.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1979.

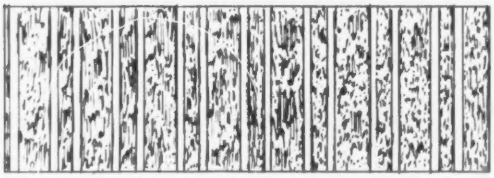
B. Wagner, Willis H. *Modern Carpentry.* South Holland, Illinois: The Goodheart-Willcox Co., Inc., 1976.

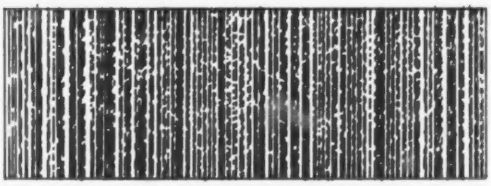
EXTERIOR WALLS AND TRIM
UNIT III

SUPPLEMENT #1 — SURFACE TEXTURES AND DESIGNS OF SIDING


BRUSHED


PLANK TEXTURED
(CIRCULAR SAWN)


CORRUGATED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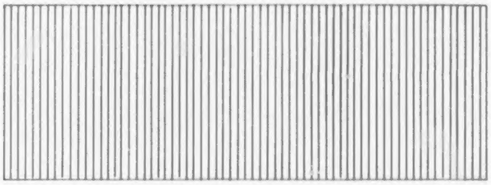
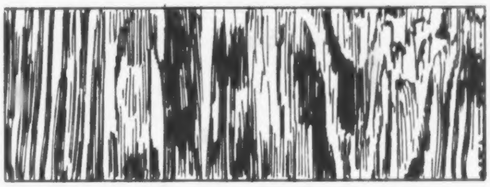
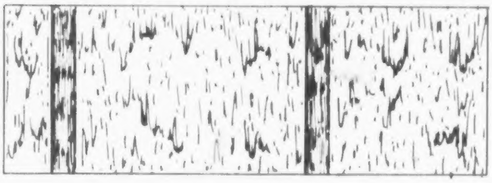
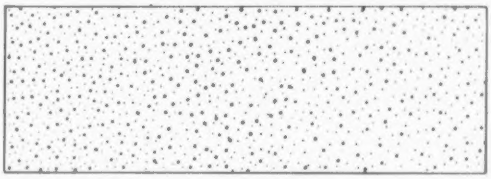

FINE LINE


TEXTURED-REVERSE-BOARD
AND
BATTEN


TEXTURED ONE-ELEVEN
(T-111)


AGGREGATE

EXTERIOR WALLS AND TRIM
UNIT III

SUPPLEMENT #2 — FASTENERS, HARDWARE, AND ACCESSORIES USED WITH SIDING

Metal flashing for windows and doors

Inside and outside metal corners for horizontal siding

Zinc-coated steel nails, aluminum nails, or any other noncorrosive nails

(NOTE: Nails will vary in size from 6d to 9d, depending on the thickness of the siding and the type of sheathing used.)

4d, 1½-inch rust-resistant nails for wood shingles

Spiral or screw-thread face nail (mineral-fiber shingles)

Metal mounting strip for lap siding

Metal joint molding for lap siding

Metal starter strips

Patented aluminum fasteners

Special aluminum trim strips

Grounding wire for aluminum siding

Starter strip for vinyl siding

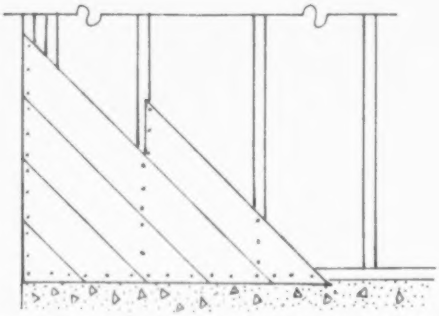
General-purpose trim for vinyl siding

Window and door cap for vinyl siding

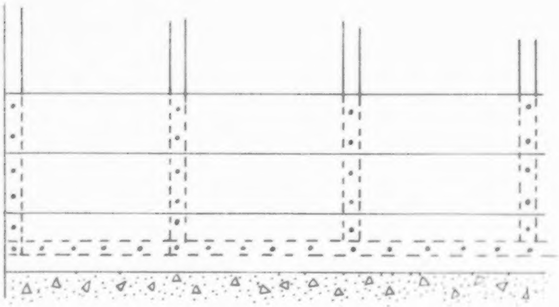
Inside and outside corners for vinyl siding

Metal lath and furring strips for stucco

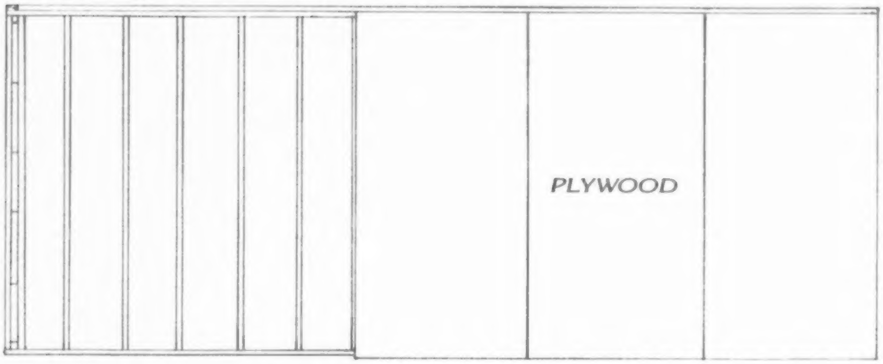
Types Of Sheathing



DIAGONAL SHEATHING



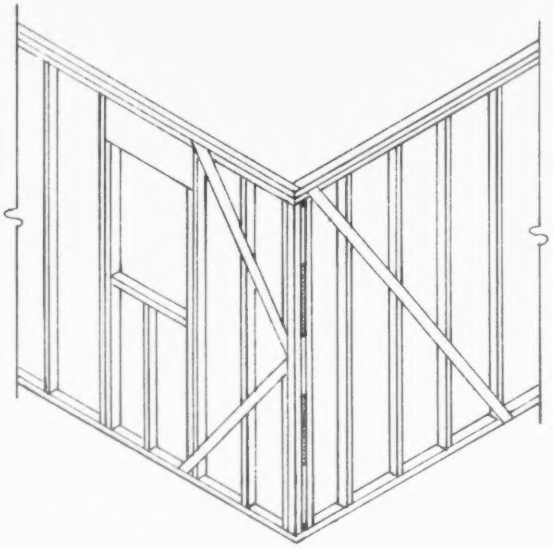
HORIZONTAL SHEATHING



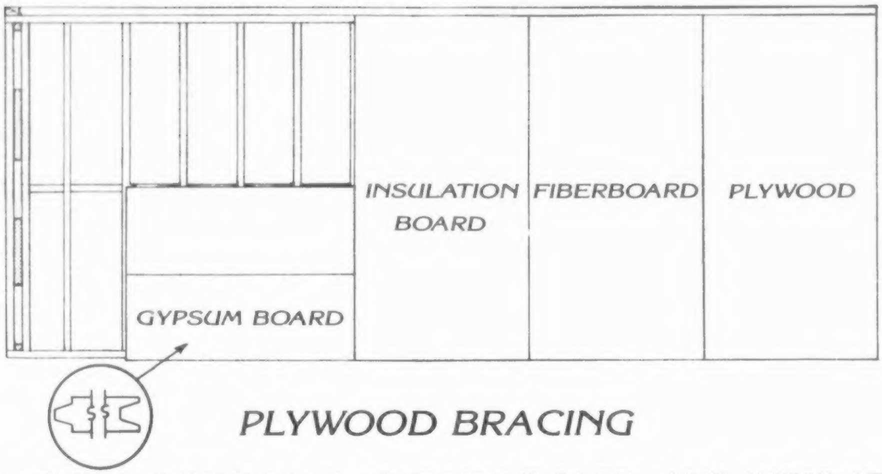
PLYWOOD SHEATHING

(NOTE: THESE TYPES OF SHEATHING DO
NOT REQUIRE ADDITIONAL BRACING.)

Types of Bracing



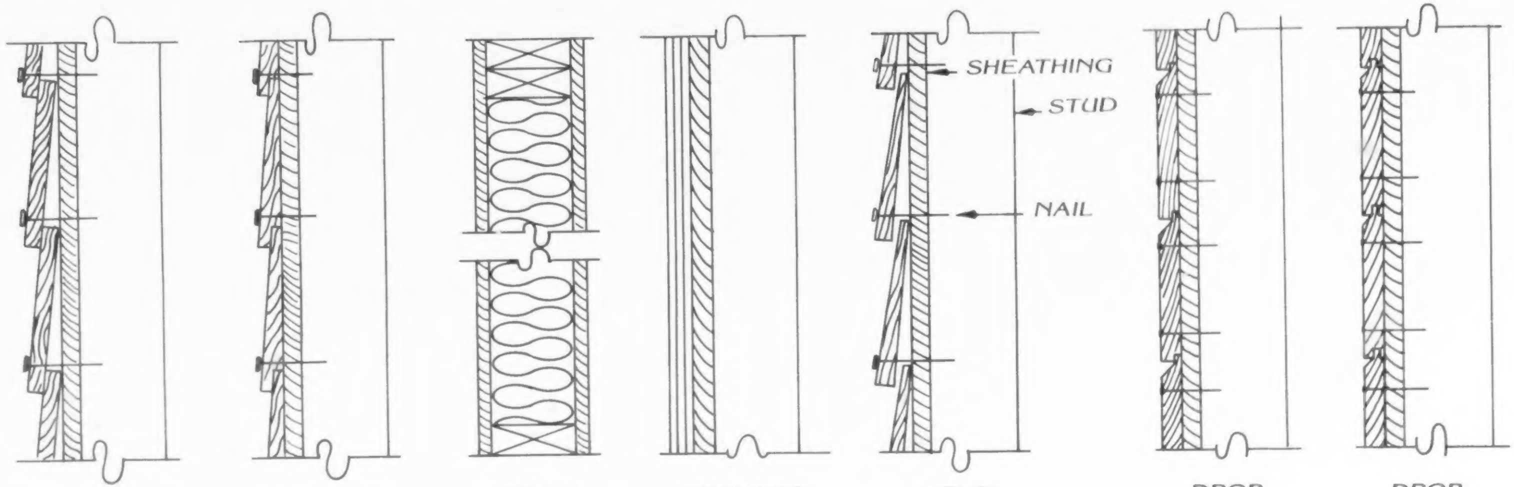
INLET BRACING


INSULATION BOARD
FIBERBOARD
PLYWOOD
GYPSUM BOARD

PLYWOOD BRACING

(NOTE: WITH FIBERBOARD, GYPSUM BOARD, AND INSULATION BOARD SHEATHING, USE INLET DIAGONAL BRACING OR PLYWOOD AT EACH CORNER.)

Types of Siding


SHEATHING
STUD
NAIL
CLAPBOARDS
BEVEL SIDING (Rabbeted)
FOAM CORE PANEL
PLYWOOD SIDING
BEVEL SIDING (Lapped)
DROP SIDING (Shiplapped)
DROP SIDING (Tongue and Grooved)

EXTERIOR WALLS AND TRIM
UNIT III

INFORMATION SHEET

I. Terms and definitions

A. Sheathing — Structural covering of boards or prefabricated panels that are attached to exterior studs and rafters

B. Siding — Any of various wood or manufactured products designed for use as the exterior finish of a structure

C. Hardboard — Manufactured, wood-fiber material shaped into boards or panels for use as siding

D. Mineral fiber — Substance made from mineral fibers and portland cement and formed into shingles for use as siding

E. Stucco — Mixture of portland cement, sand, lime, and water applied in a plastic state to form a hard covering for exterior walls

F. Gypsum board — Sheathing made of gypsum covered with a weatherproofed paper; usually tongue and grooved and used on exterior walls

G. Furring strip — Narrow strip of wood used to form a nailing base for or to level another surface, to form an air space between two surfaces, or to give a thicker appearance to a surface

H. Let-in bracing — Narrow boards nailed diagonally on wall studs to brace walls when using sheathing materials that will not withstand lateral stress

(NOTE: Studs are notched out [routed] so that the braces are flush with the outside of the stud when they are nailed in place.)

I. Batten — Strip of wood used to cover joints in a surface

J. Brick molding — Molding for exterior window and door frames against which the finished brick is laid

K. Mullion — Slender wood or metal strip forming a division between units of windows, screens, door panels, or similar frames

II. Types of wall sheathing

A. Fibered cement

B. Fiberboard

C. Gypsum board

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INFORMATION SHEET

D. Insulation board

E. Plywood or hardboard panel

F. Solid wood

G. Sheathing paper (building paper)

(NOTE: When using fiber, gypsum, or insulation board, walls will have to be braced with 1×4 let-in bracing or with vertical plywood at each corner. Solid-wood sheathing may be applied horizontally or diagonally.)

III. Categories of wall coverings

A. Horizontal siding

1. Solid boards
2. Hardboard
3. Metal
4. Vinyl

B. Vertical siding

1. Plywood
2. Boards and battens
3. Hardboard
4. Plain-surfaced or patterned boards
5. Metal
6. Vinyl

C. Shingles

1. Wood
2. Mineral fiber
3. Wood panels with shingles

D. Masonry

(NOTE: These materials are usually installed as a veneer over the framework.)

1. Stucco

INFORMATION SHEET

2. Brick
3. Stone
4. Concrete
5. Concrete products

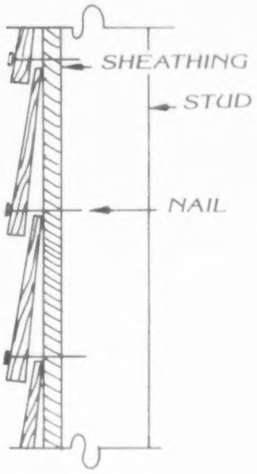
   (NOTE: Concrete products are imitation stone made from special concrete mixes.)

IV. Siding styles (Figures 1-7)

(NOTE: Most siding styles are available in either wood or hardboard.)

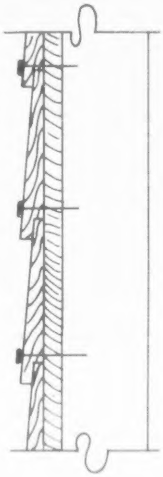
A. Bevel siding (lapped)

FIGURE 1



B. Bevel siding (rabbeted)

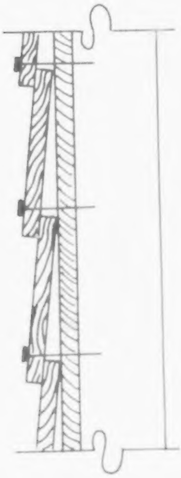
FIGURE 2



INFORMATION SHEET

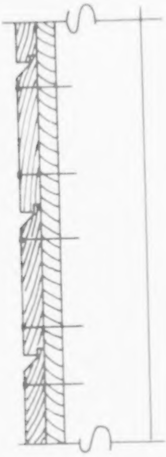
C. Clapboard

FIGURE 3



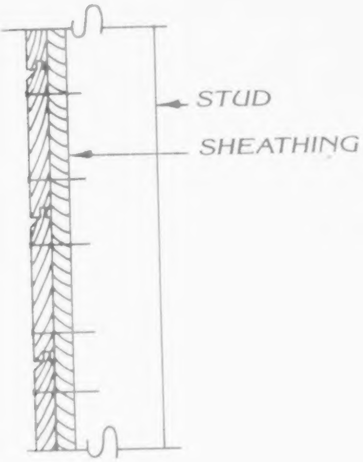
D. Drop siding (shiplapped or rustic)

FIGURE 4



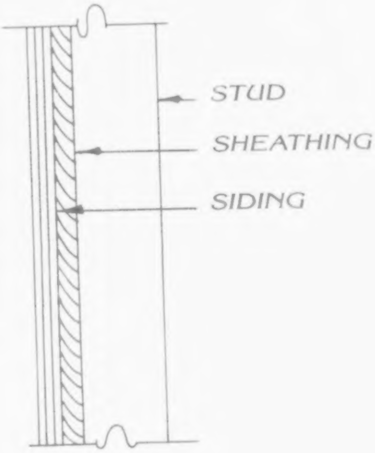
E. Drop siding (tongue and grooved)

FIGURE 5


STUD
SHEATHING

F. Plywood or hardboard panel

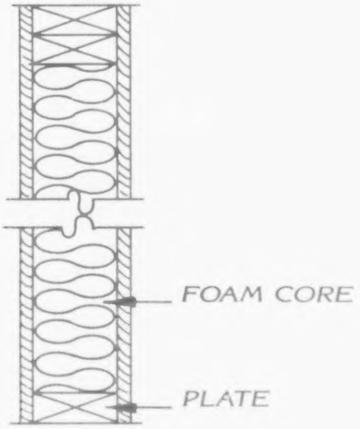
FIGURE 6


STUD
SHEATHING
SIDING

INFORMATION SHEET

G. Foam-core panel

FIGURE 7

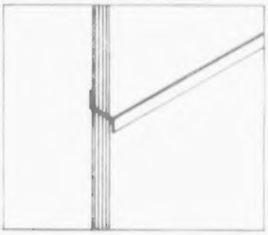


V. Joint details for plywood siding (Figures 8-15)

(NOTE: Plywood and some hardboard joints may be finished for strength, protection from the elements, or appearance. Vertical joints are normally butted against each other or shiplapped. Horizontal joints generally use a shiplap, flashing, or some other design to prevent water from entering. All plywood edges should be sealed with paint or special caulking.)

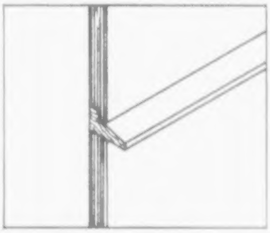
A. Metal flashing

FIGURE 8



B. Drip cap (wood watertable)

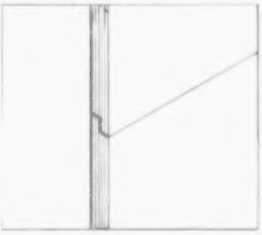
FIGURE 9



INFORMATION SHEET

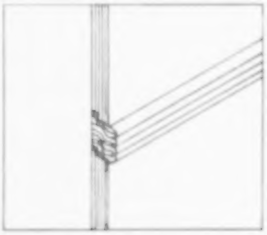
C. Shiplapped

FIGURE 10



D. Shiplapped molding

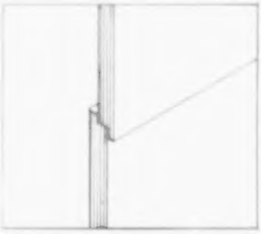
FIGURE 11



E. Double shiplapped

(NOTE: Double shiplap is normally used for horizontal joints with the vertical joints shiplapped.)

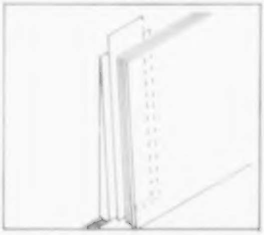
FIGURE 12



F. Lapped

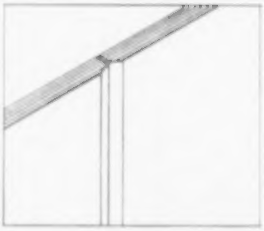
(NOTE: Horizontal joints may be lapped using a wedge and building paper. Vertical joints are normally butted with this application.)

FIGURE 13



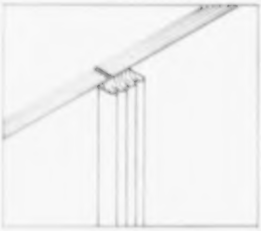
G. Vee joint

FIGURE 14



H. Molded batten

FIGURE 15



INFORMATION SHEET

VI. Types of exterior moldings and trims (Figures 16-30)

A. Batten

FIGURE 16

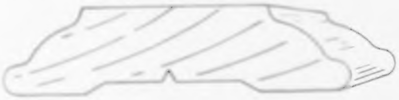
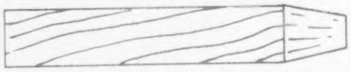


FIGURE 17



B. Bed molding

FIGURE 18

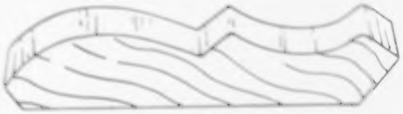
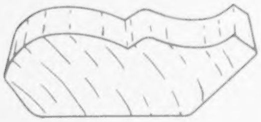


FIGURE 19



C. Brick molding

FIGURE 20

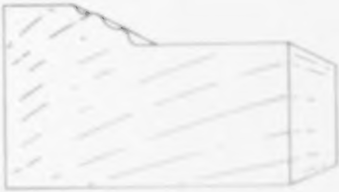
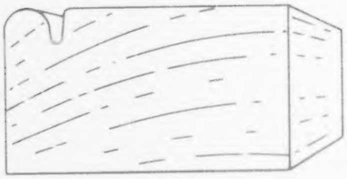


FIGURE 21



D. Corner molding

FIGURE 22: Outside

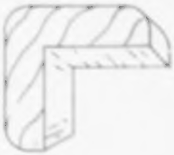
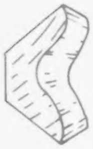


FIGURE 23: Inside



INFORMATION SHEET

E. Cove molding

FIGURE 24

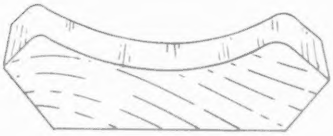
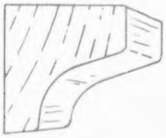


FIGURE 25



F. Crown molding

FIGURE 26

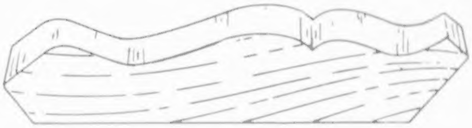
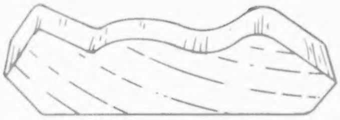
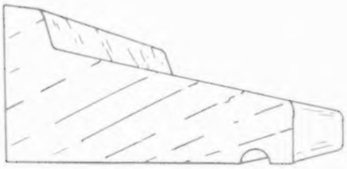


FIGURE 27



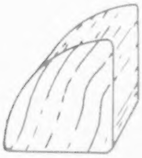
G. Drip cap

FIGURE 28



H. Quarter round molding

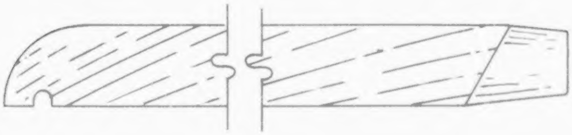
FIGURE 29



INFORMATION SHEET

I. Water stop or sill

FIGURE 30



VII. Recommendations for waterproofing exterior walls

- A. Use flashing and drip cap over windows, doors, and other openings
- B. Give all exterior siding and trim a primer coat of paint or a coat of water-repellent preservative
- C. Use material that is free of knots, pitch pockets, and other defects
- D. Store siding inside or cover with weatherproof material until it is applied
- E. Be sure the structure is dry before applying siding
- F. Maintain minimum requirements when installing siding
- G. Be sure to fit siding tightly against window and door casings, corners, and adjoining boards per manufacturer's instructions
- H. Embed all joints in an approved caulking compound
- I. Use only noncorrosive nails and fasteners
- J. Use batten strips on all vertical joints

VIII. Estimating materials for exterior walls

- A. Sheathing boards or solid-wood siding
  - 1. Determine number of square feet in area to be covered

    (NOTE: Be sure to consider the type of wall bracing to be used. For example, if plywood bracing is used at the corners with styrofoam sheathing, deduct the area covered by plywood when estimating styrofoam sheathing.)

    - a. For rectangular areas, multiply length times height;

      L × H = Area of Rectangle

INFORMATION SHEET

b. For triangular areas, multiply height by width and divide by 2;

$$\frac{W \times H}{2} = \text{Area of Triangle}$$

2. Subtract total area of openings

   (NOTE: Omit this step for 2×8 and 4×8 material.)

3. Allow for waste

   a. For 2×8 or 4×8 material, do not omit area of openings except for large openings such as garage doors

   b. For boards, add percentages shown in Table 1 for type of board and installation pattern

TABLE 1 — Waste Allowances

Siding	Size & Lap	Percent to Add
Bevel siding	1×4 - ¾"	45%
	1×5 - ⅞"	38%
	1×6 - 1"	33%
	1×8 - 1¼"	33%
	1×10 - 1½"	29%
	1×12 - 1½"	23%
Drop siding and rustic (Shiplapped)	1×4	28%
	1×5	21%
	1×6	19%
	1×8	16%
Drop siding and rustic (Dressed and matched)	1×4	23%
	1×5	18%
	1×6	16%
	1×8	14%
Triangular areas or diagonal installation		10%*

*The 10 percent is in addition to other allowance.

4. Determine number of sheets required for 2×8 or 4×8 material

   a. Divide area by area of sheet

   EXAMPLES: Divide by 16 for 2×8 material and by 32 for 4×8 material.

INFORMATION SHEET

b. Round off any portion of a sheet by increasing to next whole number

EXAMPLE #1. A building has a wall perimeter (total lineal feet of all walls) of 140 feet, wall height of 8 feet, and openings that total 240 square feet. Cover it with 1×8 bevel siding with 1¼-inch lap.

Area to be covered:
8 ft × 140 ft = 1120 sq ft
1120 sq ft − 240 sq ft = 880 sq ft

Siding estimate:
880 sq ft + 33% of 880 sq ft
= 880 sq ft + 290 sq ft
= 1170 sq ft

EXAMPLE #2. Cover a building (wall perimeter is 144 feet and walls are 8 feet high) with 4×8 plywood siding.

Area to be covered:
8 ft × 144 ft = 1152 sq ft

Siding estimate:
1152 sq ft ÷ 32 sq ft per sheet = 36 sheets

EXAMPLE #3. Cover a gable 7 feet high and 30 feet wide, using 1×8 bevel siding with 1¼–inch lap.

Area to be covered:

$$\frac{7 \text{ ft} \times 30 \text{ ft}}{2} = 105 \text{ sq ft}$$

Siding estimate:
105 sq ft + 33% of 105 sq ft + 10% of 105 sq ft
= 105 sq ft + 34.7 sq ft + 10.5 sq ft
= 150 sq ft

B. Trim--Order to nearest even foot over amount of lineal feet needed

RC - 201-E

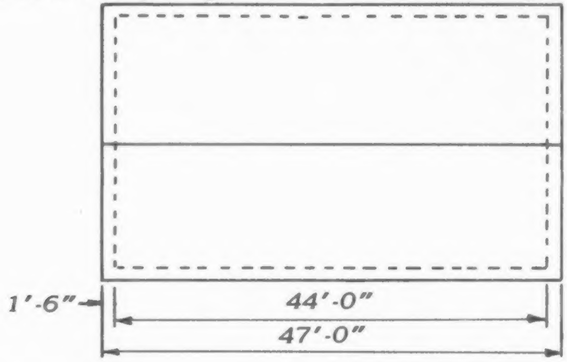
EXTERIOR WALLS AND TRIM
UNIT III

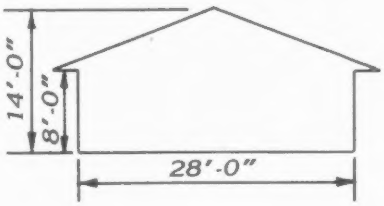
ASSIGNMENT SHEET #1 — ESTIMATE SIDING FOR A HOUSE WITH A GABLE ROOF

NAME ______________________________ SCORE ______________

The competent carpenter knows how to estimate materials quickly and accurately for a specific job. Accurate estimates are cost effective and eliminate needless waste of materials and time.

Estimate amount of 1×6 rustic drop siding (shiplapped) for the building illustrated below. The area of the openings is 272 square feet. Show your work.





Siding estimate = ______________________________

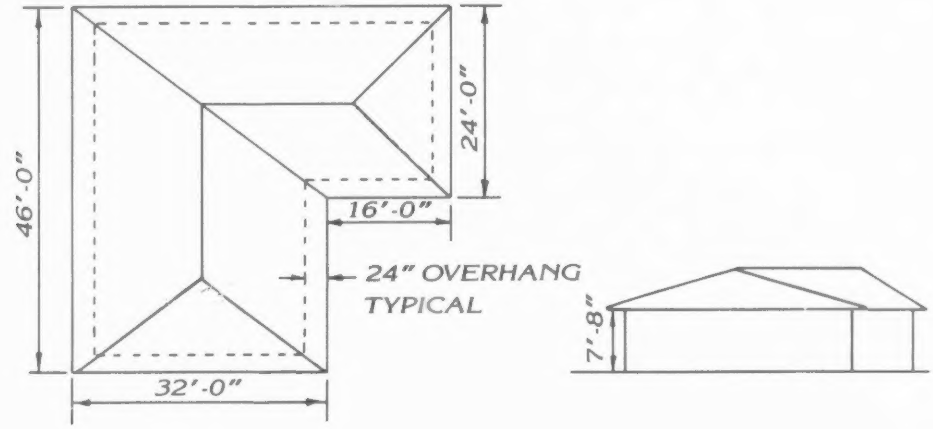
EXTERIOR WALLS AND TRIM
UNIT III

ASSIGNMENT SHEET #2 — ESTIMATE SHEATHING AND SIDING FOR A HOUSE WITH A HIP ROOF

NAME ______________________________ SCORE ______________

The carpenter should be able to estimate materials accurately. This assignment sheet will give you practice in becoming quick and accurate in estimating.

Estimate the amount of 4′×8′ fiberboard sheathing with plywood bracing and 4′×8′ plywood siding for the building illustrated below. The area of the openings is 198 square feet. Show your work.



A. Sheathing estimate = ______________________________

B. Siding estimate = ______________________________

EXTERIOR WALLS AND TRIM
UNIT III

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

1264 sq ft

Assignment Sheet #2

A. Sheathing — 794 sq ft or 25 sheets
B. Siding — 1562 sq ft or 49 sheets

EXTERIOR WALLS AND TRIM
UNIT III

JOB SHEET #1 — INSTALL SHEATHING

I. Tools and materials

- A. Power handsaw and extension cord
- B. Folding rule or steel tape
- C. Claw hammer
- D. Framing square
- E. Chalk line
- F. Straightedge
- G. Fiberboard
- H. Gypsum board (Gyplap)
- I. Plywood
- J. 1×4 for diagonal braces
- K. Nails
    - 1. 2-inch barbed roofing for fiberboard
    - 2. $1\frac{1}{2}$-inch barbed roofing for gypsum board
    - 3. 6d box for plywood
    - 4. 8d box for braces

II. Procedure for fiberboard or insulation-panel sheathing with plywood corner bracing

(NOTE: Follow manufacturer's recommendations for nailing, joints, and installation.)

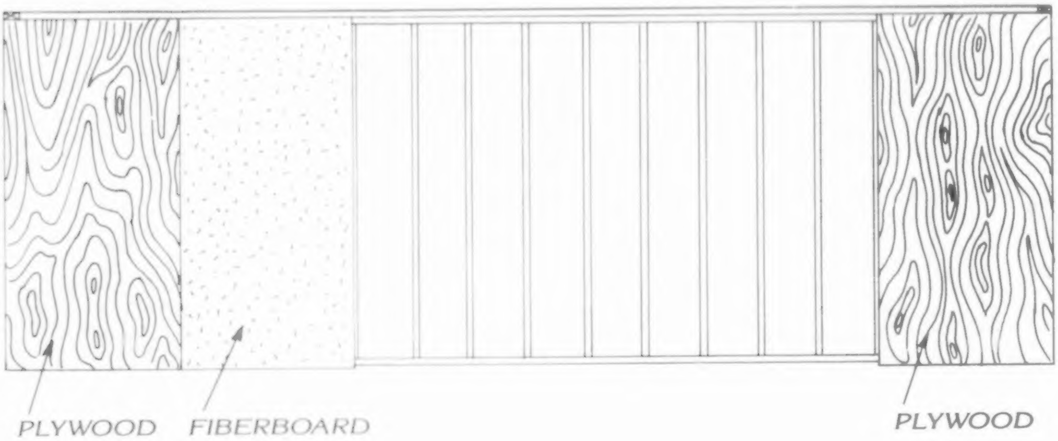
- A. Apply a full sheet of plywood to each exterior corner of structure
    - 1. Chalk line vertically on sheathing at each stud
    - 2. Start at bottom of corner of one wall and tack panel in place
    - 3. Complete nailing
        - a. Space nails 6-inches on center for edges
        - b. Space nails 12 inches on center at each stud

JOB SHEET #1

4. Continue procedure, lapping edges of plywood at corners until all plywood bracing has been installed

B. Apply sheathing (Figure 31)

FIGURE 31



1. Chalk lines vertically on sheathing at each stud

2. Tack panels in place

3. Complete nailing

   a. Space nails 3 inches on center at edges

   b. Space nails 6 inches on center at each stud

C. Check work for accuracy and soundness

D. Clean work area and return tools and materials to proper storage

III. Procedure for gypsum-board sheathing with let-in diagonal bracing

A. Start at bottom of corner of one wall

B. Chalk lines vertically on sheathing at each stud

C. Tack panel in place with top side up (See Figure 32)

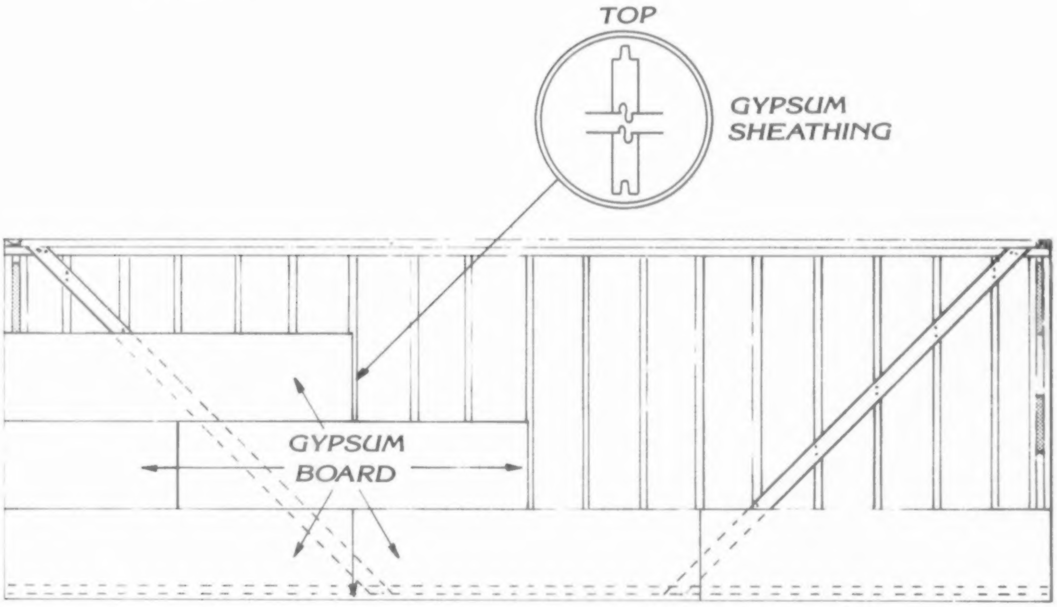
D. Complete nailing procedures

(NOTE: Nail as required for type of exterior finish to be used.)

JOB SHEET #1

E. Continue installation, working up from bottom and staggering joints (Figure 32)

FIGURE 32



F. Check work for accuracy and soundness

G. Clean work area and return tools and materials to proper storage

IV. Procedure for plywood sheathing

A. Install plywood panel at each corner for bracing

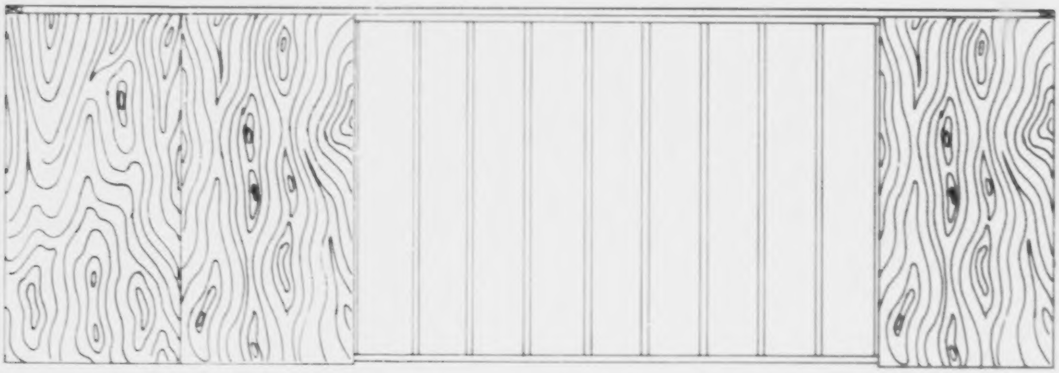
(NOTE: No additional bracing is required when plywood is used.)

1. Chalk lines vertically on each stud
2. Start at bottom of corner of wall and tack panels in place
3. Complete nailing
    a. Space nails 6 inches on center at edges
    b. Space nails 12 inches on center at each stud

JOB SHEET #1

B. Install panels between bracing, using same procedures (Figure 33)

FIGURE 33



C. Check work for accuracy and soundness

D. Clean work area and return tools and materials to proper storage

EXTERIOR WALLS AND TRIM
UNIT III

JOB SHEET #2 — INSTALL BEVEL SIDING

I. Tools and materials

    A. Radial arm saw or table saw

    B. Power handsaw and extension cord

    C. Handsaw

    D. Claw hammer

    E. Chalk line

    F. Folding rule or steel tape

    G. Framing square

    H. Try square

    I. 48-inch and 78-inch levels

    J. Caulking gun and caulking

    K. 6-inch bevel siding

    L. 1×4s for outside corners

    M. Furring strips for spacer under bottom piece of siding

    N. Spacing jig

    O. Drip caps

    P. Flashing for windows and doors

    Q. Nails (as specified)

II. Procedure

    A. Start at one corner and work around the building

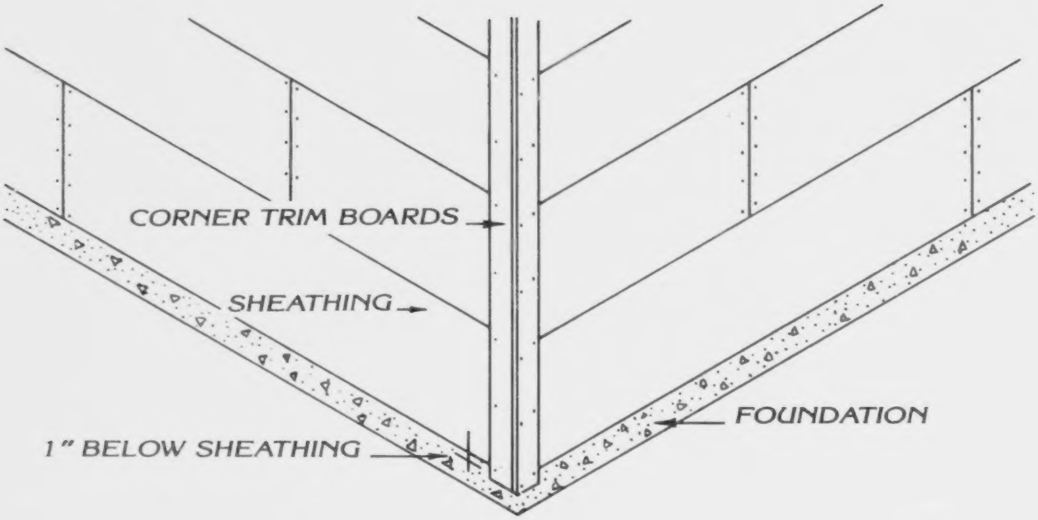
    B. Check corner for plumb

    C. Install outside corner trim boards (Figure 34)

    (NOTE: The bottom of the trim boards should extend 1 inch below the bottom of the sheathing.)

JOB SHEET #2

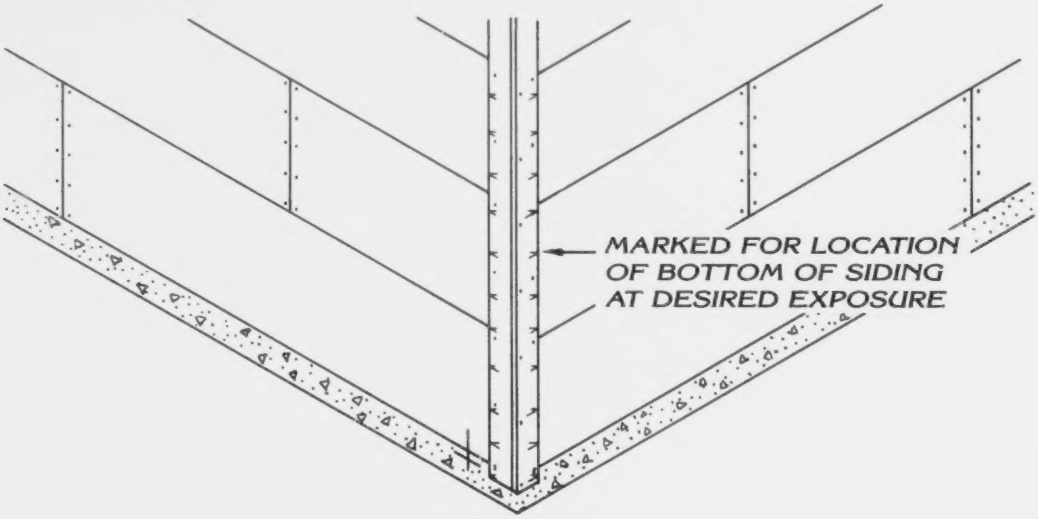
FIGURE 34


CORNER TRIM BOARDS
SHEATHING
FOUNDATION
1" BELOW SHEATHING

D. Mark on corner boards the locations for bottom of each siding board according to desired exposure as specified (Figure 35)

(NOTE: Some carpenters prefer to space bevel siding to allow for continuous pieces over openings. A story pole is used and aligned with the headers before marking siding layout.)

FIGURE 35


MARKED FOR LOCATION
OF BOTTOM OF SIDING
AT DESIRED EXPOSURE

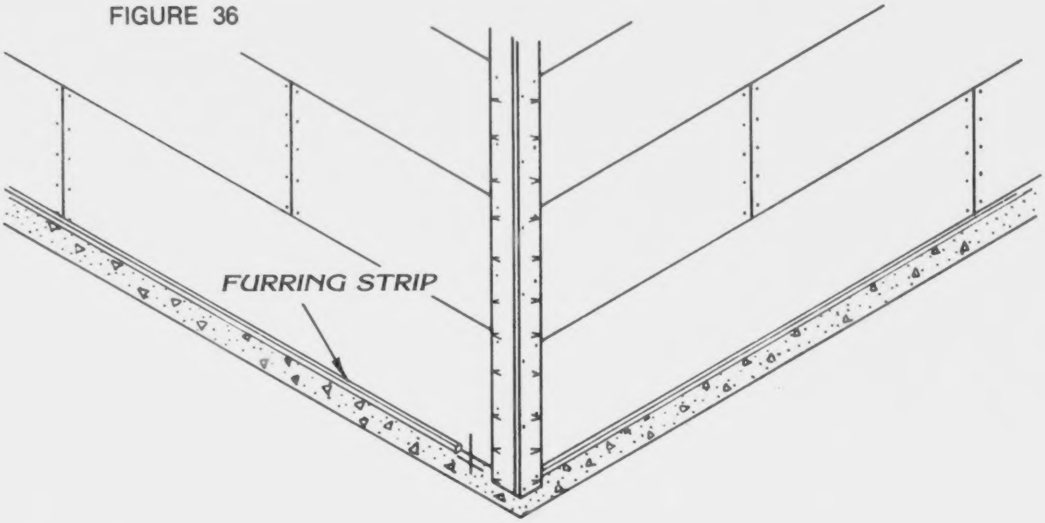
JOB SHEET #2

E. Chalk a line on sheathing at top of furring strip location

F. Cut a furring strip the thickness of top edge of siding being used and nail to bottom of wall (Figure 36)

(NOTE: This procedure is done only on drop siding.)

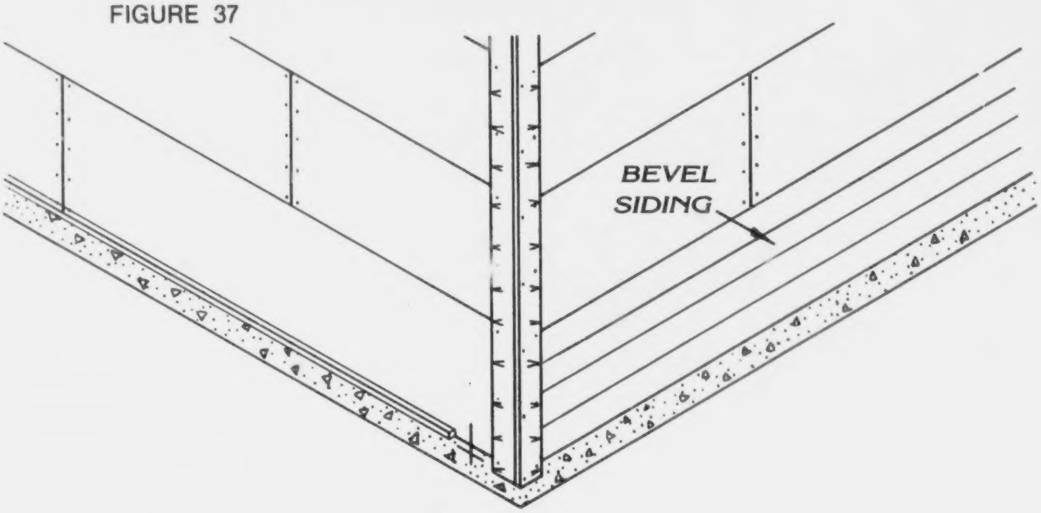
FIGURE 36



G. Snap chalk lines between marks on corner trim

H. Start siding at corner and work around (Figure 37)

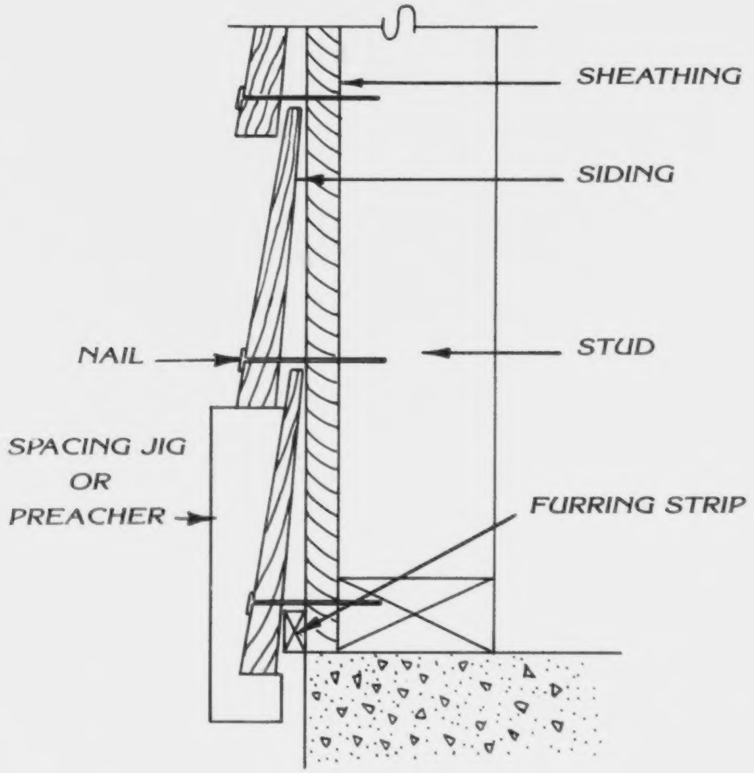
FIGURE 37



JOB SHEET #2

I. Use spacing jig (preacher) for spacing siding between corners (Figure 38)

FIGURE 38


SHEATHING
SIDING
NAIL
STUD
SPACING JIG
OR
PREACHER
FURRING STRIP

J. Continue procedure to install remaining siding, keeping joints tight, and making all splices on a stud

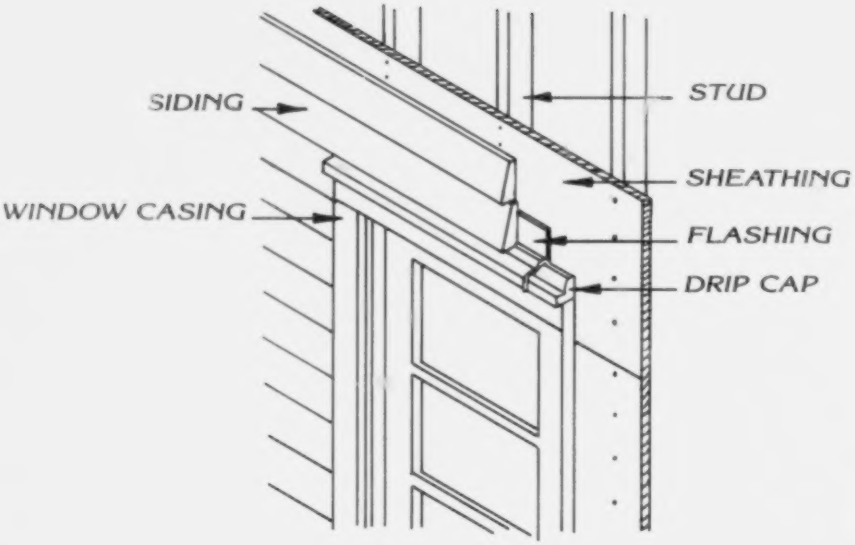
K. Install drip caps above windows and doors

L. Install flashing over windows and doors

M. Trim windows and doors (See Figure 39)

JOB SHEET #2

FIGURE 39


SIDING
WINDOW CASING
STUD
SHEATHING
FLASHING
DRIP CAP

N. Caulk all joints around windows, doors, and corners

O. Check work for accuracy and soundness

P. Clean work area and return tools and materials to proper storage

EXTERIOR WALLS AND TRIM
UNIT III

JOB SHEET #3 — INSTALL SHEATHING AND PLYWOOD SIDING

I. Tools and materials

A. 48-inch level and straightedge

B. Framing square

C. Claw hammer

D. Folding rule or steel tape

E. Handsaw

F. Power handsaw and extension cord

G. Chalk line

H. Caulking gun and caulking

I. Sawhorses

J. 4×8 fiberboard sheathing

K. 4×8 exterior plywood siding

L. 1×4s for braces

M. 6d and 8d box nails as specified

(NOTE: Staples or T-nails may be used.)

N. Water-repellent, nonstaining felt backing strips

II. Procedure

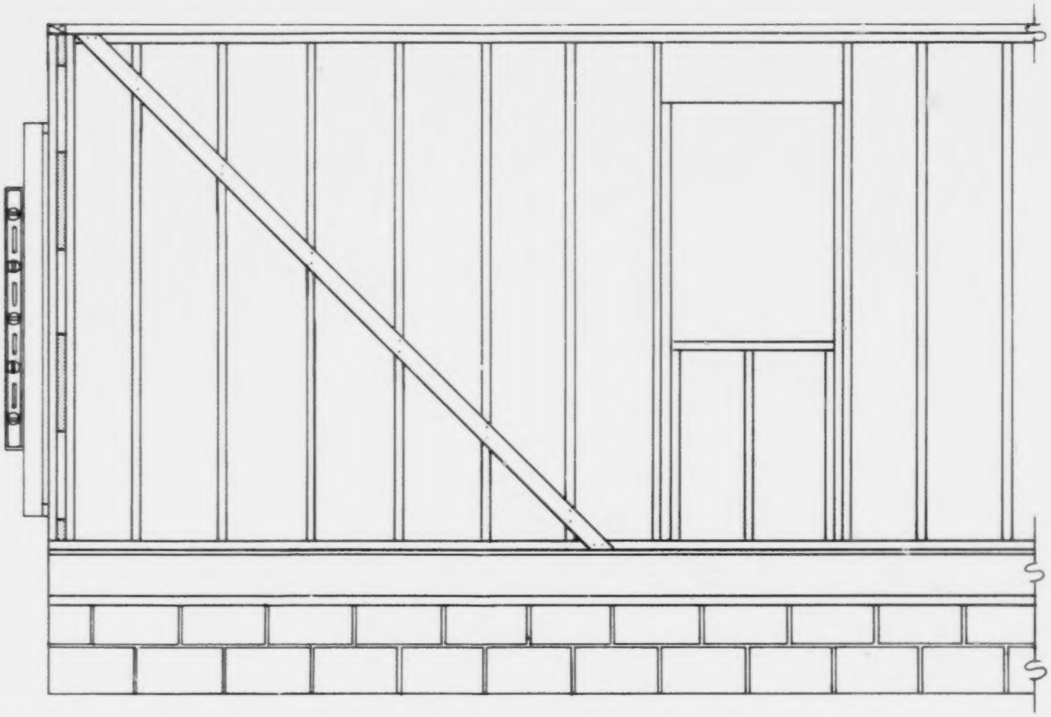
(NOTE: Chalk wall layout lines on panels before erecting them.)

A. Check corner for plumb as it may be necessary to scribe and cut first sheet of sheathing and siding (See Figure 40)

(NOTE: A level, as in Figure 40, or a plumb bob may be used.)

JOB SHEET #3

FIGURE 40



B. Install a 32-inch-wide sheet of sheathing at corner

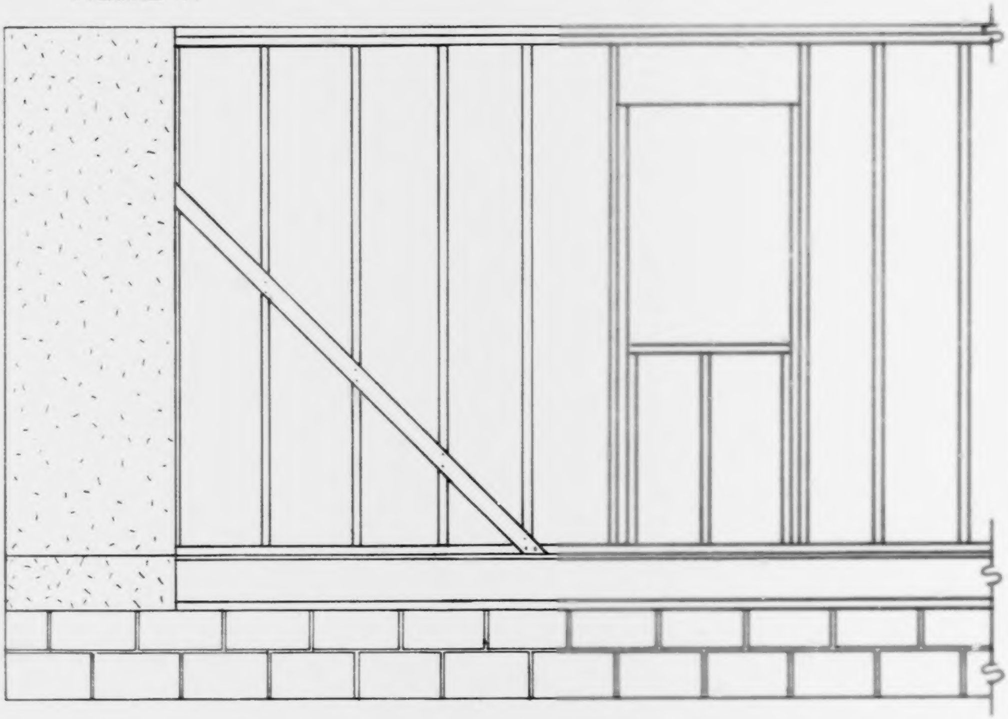
(NOTE: This narrow piece is necessary to avoid having the joints of the sheathing and siding fall on the same stud. If plywood bracing is used, install a 32-inch-wide sheet of siding as the first piece of siding.)

C. Tack first piece of sheathing in place

D. Cut and install a band of sheathing to cover sill if necessary (See Figure 41)

JOB SHEET #3

FIGURE 41



E. Run a bead of caulking along vertical joint of first piece of sheathing

(NOTE: Use caulking on all vertical joints.)

F. Install next sheet of sheathing

G. Chalk a line vertically every 4 feet or at each stud at location of siding joint

H. Install backing strips over chalk lines at joints

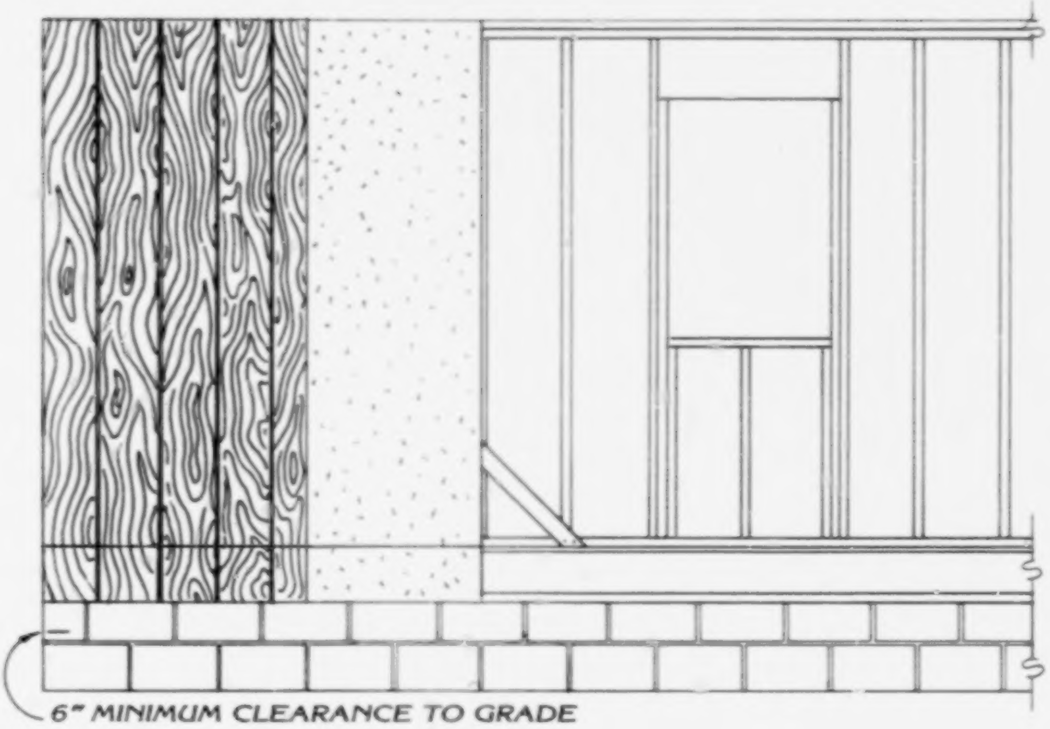
I. Nail up first sheet of siding (See Figure 42)

  1. Space nails every 6 inches on edges and every 12 inches on intermediate studs

  2. Place nails about 3/8 inch from edge of panels

JOB SHEET #3

FIGURE 42



(NOTE: Whenever possible, cut the siding from the unfinished side. If it is necessary to cut the siding from the finished side, protect the finish by taping paper to the underside of the power saw. Where corner trim is used, it may not be necessary to scribe and cut siding.)

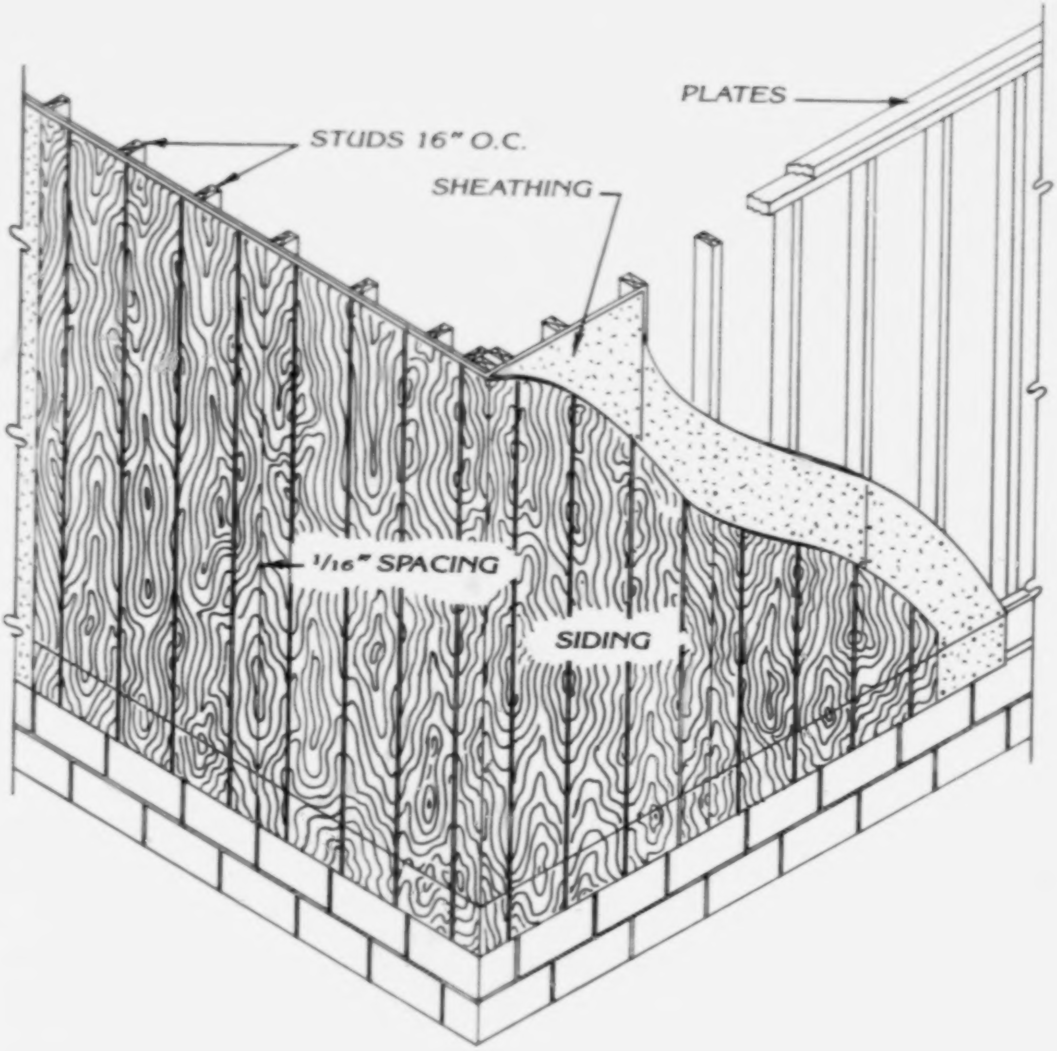
J. Continue installing sheathing and siding, leaving 1/16-inch spacing at all edges and ends of siding for shrinkage (See Figure 43)

K. Continue to caulk all vertical joints

(NOTE: When installing horizontal siding, use flashing and caulking; Z flashing is recommended.)

JOB SHEET #3

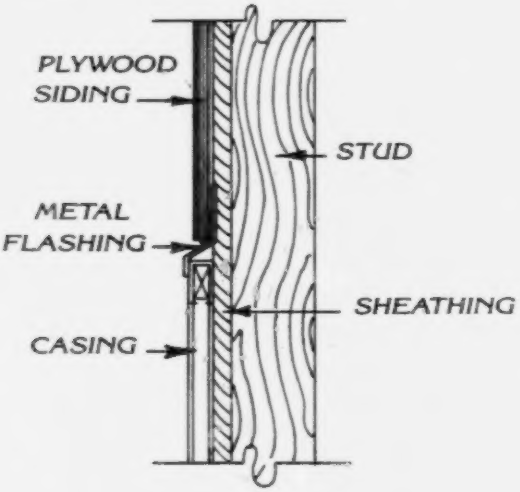
FIGURE 43


PLATES
STUDS 16" O.C.
SHEATHING
1/16" SPACING
SIDING

JOB SHEET #3

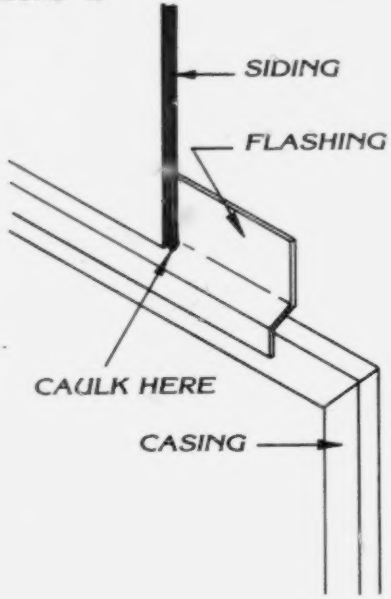
L. Install flashing over windows and doors (Figure 44)

FIGURE 44


PLYWOOD SIDING
STUD
METAL FLASHING
SHEATHING
CASING

M. Caulk over windows and doors (Figure 45)

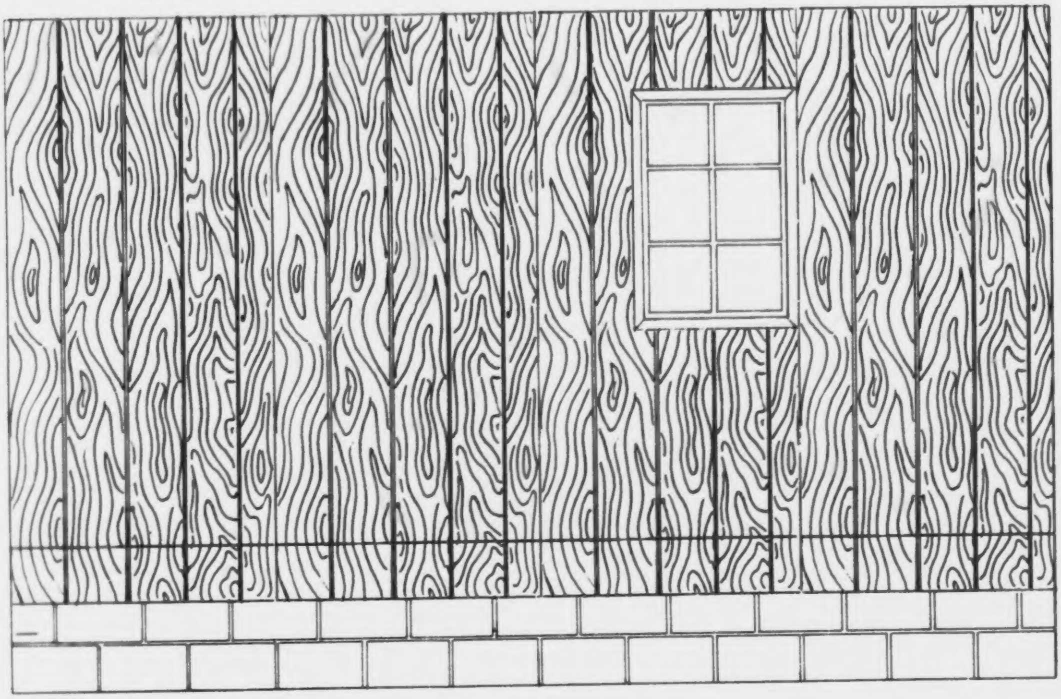
FIGURE 45


SIDING
FLASHING
CAULK HERE
CASING

JOB SHEET #3

N. Continue fitting and nailing until siding is completed (Figure 46)

FIGURE 46



O. Check work for accuracy and soundness

P. Clean work area and return tools and materials to proper storage

EXTERIOR WALLS AND TRIM
UNIT III

TEST

NAME ____ SCORE ________________

1. Match to their correct definitions terms associated with exterior wall finishes and trim. Write the correct numbers in the blanks.

______a. Substance made from mineral fibers and portland cement and formed into shingles for use as siding

______b. Manufactured, wood-fiber material shaped into boards or panels for use as siding

______c. Slender wood or metal strip forming a division between units of windows, screens, door panels, or similar frames

______d. Molding for exterior window and door frames against which the finished brick is laid

______e. Sheathing made of gypsum covered with a weatherproofed paper; usually tongue and grooved and used on exterior walls

______f. Any of various wood or manufactured products designed for use as the exterior finish of a structure

______g. Narrow strip of wood used to form a nailing base for or to level another surface, to form an air space between two surfaces, or to give a thicker appearance to a surface

______h. Mixture of portland cement, sand, lime, and water applied in a plastic state to form a hard covering for exterior walls

______i. Narrow boards nailed diagonally on wall studs to brace walls when using sheathing materials that will not withstand lateral stress

______j. Structural covering of boards or prefabricated panels that are attached to exterior studs and rafters

______k. Strip of wood used to cover joints in a surface

1. Gypsum board
2. Mullion
3. Let-in bracing
4. Batten
5. Hardboard
6. Stucco
7. Brick molding
8. Sheathing
9. Mineral fiber
10. Furring strip
11. Siding

TEST

2. Name four types of wall sheathing.

a. ____

b. ____

c. ____

d. ____

3. Match types of wall coverings to their correct categories. Write the correct numbers in the blanks. Some answers may have more than one number.

_____a. Wood panels with shingles

_____b. Brick

_____c. Concrete

_____d. Metal

_____e. Mineral fiber

_____f. Boards and battens

_____g. Vinyl

_____h. Stucco

_____i. Hardboard

_____j. Wood

_____k. Concrete products

_____l. Plywood

_____m. Plain-surfaced or patterned boards

_____n. Stone

_____o. Solid boards

1. Horizontal siding
2. Vertical siding
3. Shingles
4. Masonry

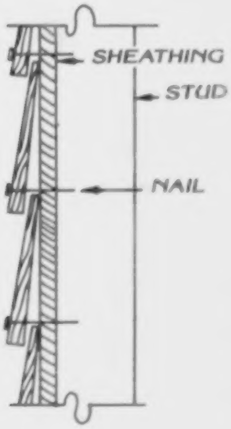
TEST

4. Identify the following styles of siding. Write correct names in blanks.

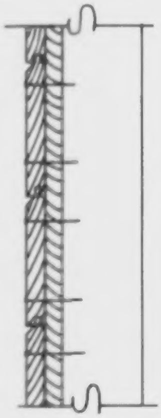
Drop siding (shiplapped or rustic)
Foam-core panel

Plywood or hardboard panel
Bevel siding (lapped)
Clapboard

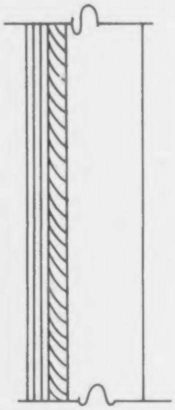
Bevel siding (rabbeted)
Drop siding (tongue and grooved)



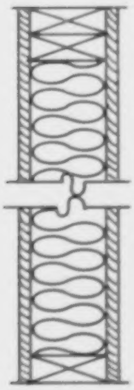
a. ________________



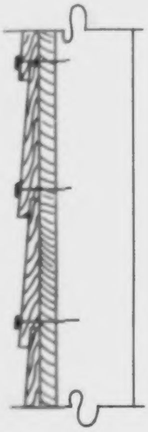
b. ________________



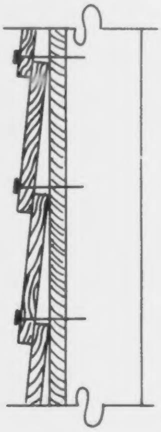
c. ________________



d. ________________

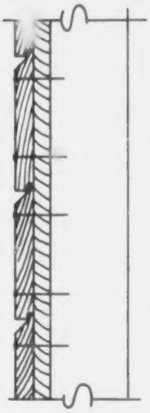


e. ________________



f. ________________

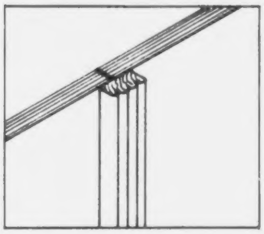
TEST



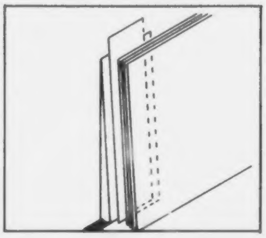
g. ______________________________

5. Identify the following joint details for plywood siding. Write the correct names in the blanks.

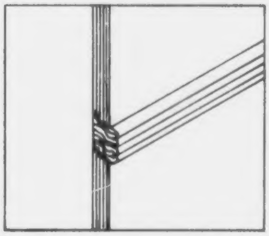
Metal flashing
Shiplapped molding
Drip cap (wood watertable)
Lapped
Vee joint
Shiplapped
Molded batten
Double shiplapped



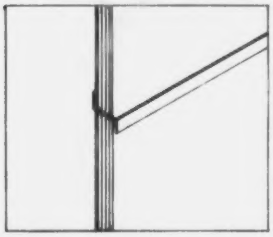
a. ______________________________



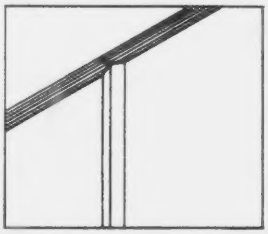
b. ______________________________



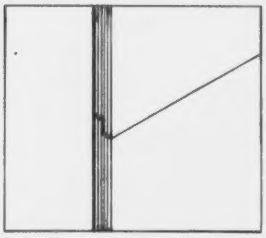
c. ______________________________



d. ______________________________

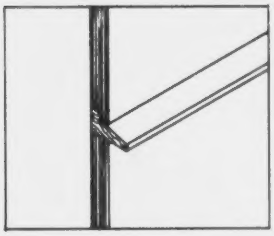


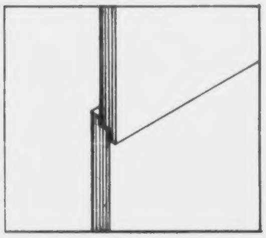
e. ______________________________



f. ______________________________

TEST

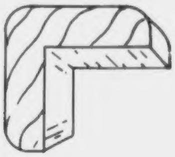




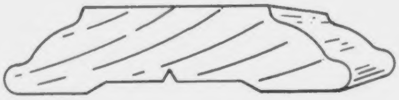
g. ______________________ h. ______________________

6. Identify the following types of exterior moldings and trims. Write the correct names in the blanks.

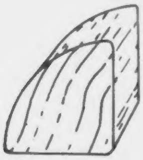
Brick molding
Drip cap
Batten
Corner molding
Water stop or sill
Bed molding
Quarter round molding
Crown molding
Cove molding



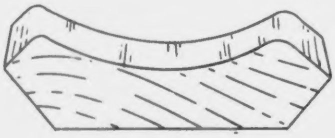
a. ______________________



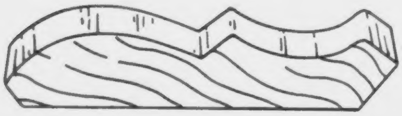
b. ______________________



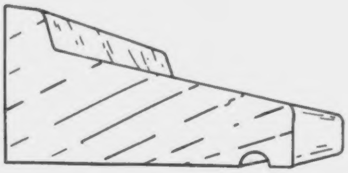
c. ______________________



d. ______________________

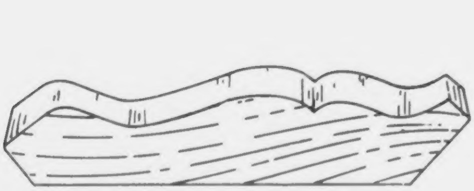


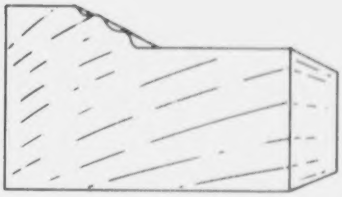
e. ______________________



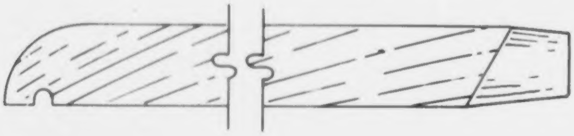
f. ______________________

TEST





g. ____________________ h. ____________________



i. ____________________

7. List five recommendations for waterproofing exterior walls.

a. ____________________

____

b. ____________________

____

c. ____________________

____

d. ____________________

____

e. ____________________

____

TEST

8. Estimate amounts of siding for the following jobs.

   a. A hip-roof building has two 8-foot walls 60 feet long and two 8-foot walls 36 feet long. Use 1×12 bevel siding with 1½-inch lap. Building has 288 square feet of openings. Waste for siding is 23 percent.

   Amount of bevel siding = ______________________________

   b. A gable-roof building with 8-foot walls has two walls 34 feet long, two walls 54 feet long, and 144 square feet of openings. Gable ends are 8′-9″ high. Use 4×8 corrugated plywood.

   Amount of corrugated plywood = ______________________________

TEST

c. A gable-roof building with 8-foot walls has two walls 26 feet long, two walls 46 feet long, and 182 square feet of openings. Gable ends are 6 feet high. Use 1×6 drop siding (dressed and matched). Waste is 16 percent for siding and 10 percent for triangular area.

Amount of drop siding = ____________________

(NOTE: Test question 9 lists the job sheets. They are an important part of the test. If they have not been completed, check with your instructor.)

9. Demonstrate the ability to

   a. Install sheathing.

   b. Install bevel siding.

   c. Install sheathing and plywood siding.

EXTERIOR WALLS AND TRIM
UNIT III

ANSWERS TO TEST

1. a. 9
   b. 5
   c. 2
   d. 7
   e. 1
   f. 11
   g. 10
   h. 6
   i. 3
   j. 8
   k. 4

2. Answer should include any four of the following
   a. Fibered cement
   b. Fiberboard
   c. Gypsum board
   d. Insulation board
   e. Plywood or hardboard panel
   f. Solid wood
   g. Sheathing paper (building paper)

3. a. 3
   b. 4
   c. 4
   d. 1, 2
   e. 3
   f. 2
   g. 1, 2
   h. 4
   i. 1, 2
   j. 3
   k. 4
   l. 2
   m. 2
   n. 4
   o. 1

4. a. Bevel siding (lapped)
   b. Drop siding (tongue and grooved)
   c. Plywood or handboard panel
   d. Foam-core panel
   e. Bevel siding (rabbeted)
   f. Clapboard
   g. Drop siding (shiplapped or rustic)

5. a. Molded batten
   b. Lapped
   c. Shiplapped molding
   d. Metal flashing
   e. Vee joint
   f. Shiplapped
   g. Drip cap (wood watertable)
   h. Double shiplapped

6. a. Corner molding
   b. Batten
   c. Quarter round
   d. Cove molding
   e. Bed molding
   f. Drip cap
   g. Crown molding
   h. Brick molding
   i. Water stop or sill

7. Answer should include any five of the following
   a. Use flashing and drip cap over windows, doors, and other openings
   b. Give all exterior siding and trim a primer coat of paint or a coat of water-repellent preservative
   c. Use material that is free of knots, pitch pockets, and other defects
   d. Store siding inside or cover with weatherproof material until it is applied
   e. Be sure the structure is dry before applying siding
   f. Maintain minimum requirements when installing siding

ANSWERS TO TEST

- g. Be sure to fit siding tightly against window and door casings, corners, and adjoining boards per manufacturer's instructions
- h. Embed all joints in an approved caulking compound
- i. Use only noncorrosive nails and fasteners
- j. Use batten strips on all vertical joints

8. a. 1535 sq ft
   b. 1562 sq ft or 49 sheets
   c. 1322 sq ft

9. Performance skills evaluated to the satisfaction of the instructor

WINDOWS
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to identify different types of windows and install a double-hung window unit. The student will show this knowledge by completing the job sheet and the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match windows and accessories to their correct descriptions.
2. Name types of sliding windows.
3. Name types of swinging windows.
4. Name types of fixed windows.
5. Select from a list types of materials used to construct windows.
6. Identify parts of a window installation.
7. Select from a list types of materials used for windowpanes.
8. State information a carpenter should know when installing windows.
9. State recommendations for a good window installation.
10. Demonstrate the ability to install a double-hung wood window unit.

WINDOWS
UNIT IV

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Supplement #1 — Benefits of Using Insulating Glass in Windows

   D. Transparency masters

      1. TM #1 — Parts of a Double-Hung Wood Window

      2. TM #2 — Parts of a Double-Hung Metal Window

   E. Information Sheet

   F. Job Sheet #1 — Install a Double-Hung Wood Window Unit

   G. Test

   H. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

   B. Obtain materials needed to supplement unit.

   C. Order transparencies and competency profiles.

   (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202—393-2040.)

   D. Introduce unit.

   SUGGESTIONS:

   - Have students list reasons for using windows in a structure.

     EXAMPLES: Light, ventilation, appearance

   - Have students list problems associated with windows.

     EXAMPLES: Heating/cooling losses, drafts, rain leaks

SUGGESTED ACTIVITIES

E. Provide students with objective sheet.

F. Discuss unit and specific objectives, relating them to your introduction of the unit.

G. Provide students with information sheet.

H. Discuss information sheet.

1. Use Information Sheet, Section I to discuss windows and accessories.

   SUGGESTIONS:

   - Provide class with examples or models of each type of window.
   - Relate the reasons for windows and problems with windows identified by the class during the introduction of the unit to each type of window.
   - Invite a representative from a window manufacturer or distributor to discuss windows, or obtain materials from manufacturers or distributors.
   - Provide class with examples of various types of mullions and muntins, and demonstrate their use.

     EXAMPLES: 1. Mullions: Wood, metal, bow or bay

     2. Muntins: Wood, plastic, metal, clip-on, internal

2. Use Information Sheet, Sections II, III, and IV to discuss classifications of windows, emphasizing those commonly used in your area.

   SUGGESTIONS:

   - Relate types of windows to specific examples.
   - Invite an architect to talk to the class about architectural considerations for windows.
   - Provide class with catalogs or other literature containing windows, and have students classify the windows by type.

3. Use Information Sheet, Section V to discuss types of materials used to construct windows.

   SUGGESTIONS:

   - Tour a window manufacturing plant.

SUGGESTED ACTIVITIES

- Provide class with samples of the materials used in window construction.

  (NOTE: Window distributors often have samples of such materials, including cut-away pieces.)

4. Use Information Sheet, Section VI and Transparency #1 to discuss window parts, emphasizing those parts involved in the installation process.

   SUGGESTIONS:

   - Use a cut-away model to reinforce information.
   - Use Transparency #2 to relate wood window parts to metal window parts; use examples and drawings to relate parts of a double-hung window to other types of windows.
   - Demonstrate the operation of hardware for various types of windows.

5. Use Information Sheet, Section VII to discuss materials used for windowpanes.

   SUGGESTIONS:

   - Provide class with samples of each type of material.
   - Discuss local regulations pertaining to the various materials.
   - Invite a glazier to talk to the class about the availability of types, sizes, and thicknesses of glass and installation techniques; ask the glazier to explain how a carpenter can help the glazier when required.
   - Provide students with Supplement #1 to discuss benefits of insulating glass; demonstrate benefits where possible, such as having students feel inside of insulating glass compared to ordinary window glass when both are exposed to a heat lamp.

6. Use Information Sheet, Section VIII to discuss information a carpenter should know when installing windows.

   SUGGESTIONS:

   - Explain the impact of the information on the window installation.
   - Provide students with window manufacturer's instructions and with house plans to show how to obtain the needed information.
   - Show students architectural representations for various types of windows.

SUGGESTED ACTIVITIES

7. Use Information Sheet, Section IX to discuss recommendations for a good window installation.

   SUGGESTIONS:

   - Visit job sites to watch window installations.
   - Demonstrate techniques and methods associated with the recommendations, such as leveling, bracing, caulking, and handling.
   - Demonstrate replacement of glass in windows.
   - Demonstrate Job Sheet #1 and allow students to practice.

I. Review unit.

J. Give test.

K. Critique test and discuss in class.

L. Reteach and retest as required.

M. Complete appropriate sections of competency profiles.

III. Unit references

A. Ramsey, Charles G. and Harold R. Sleeper. *Architectural Graphic Standards*. 6th ed. Edited by Joseph N. Boaz. New York: John Wiley and Sons, Inc., 1970.

B. Wagner, Willis H. *Modern Carpentry*. South Holland, Illinois: The Goodheart-Willcox Co., Inc. 1976.

WINDOWS
UNIT IV

SUPPLEMENT #1 — BENEFITS OF USING INSULATING GLASS IN WINDOWS

Reduces temperature difference between inside of window and room air.

Reduces downdrafts in room.

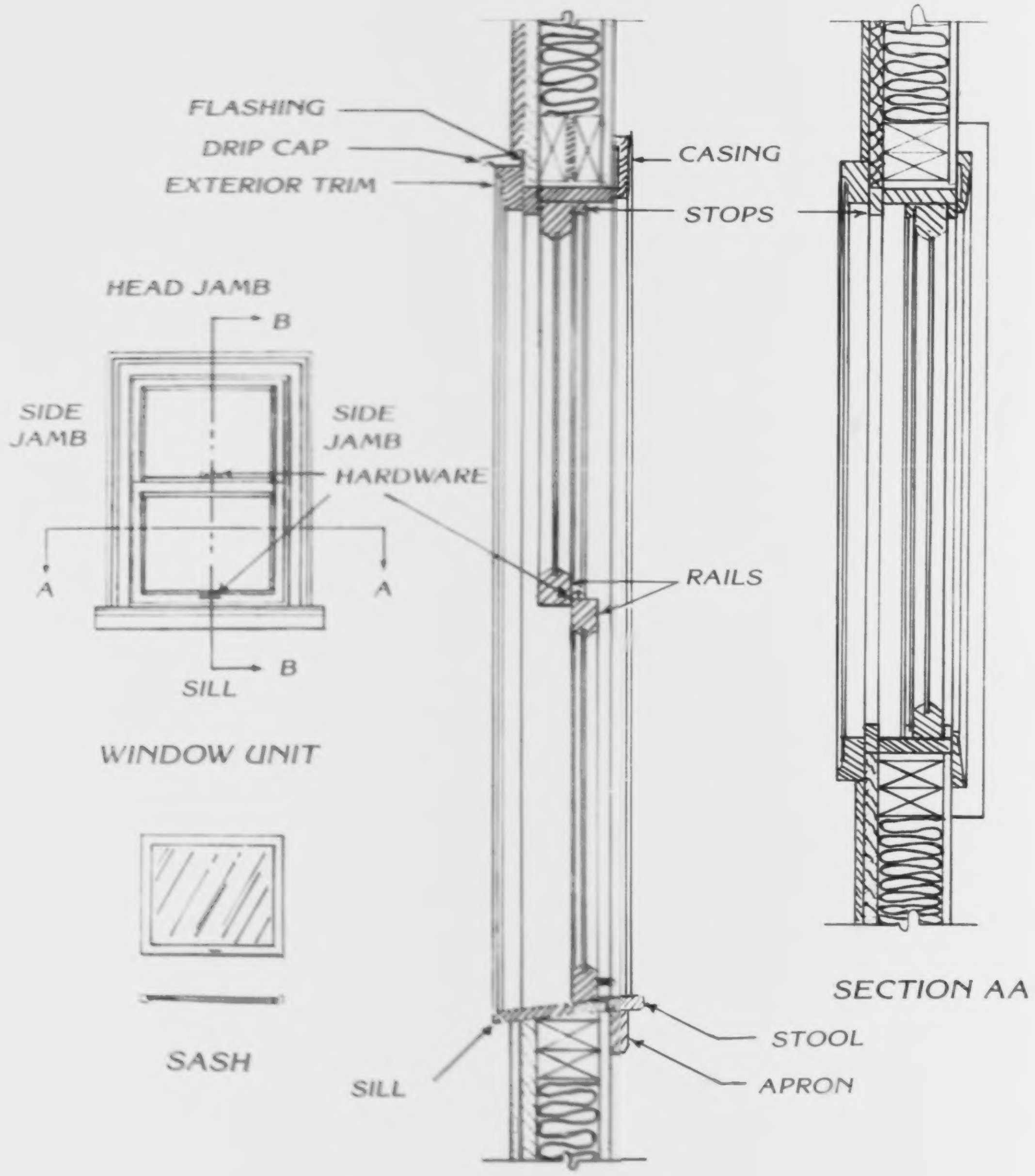
Eliminates need for storm windows.

Reduces fogging and frosting on inside of glass.

Reduces energy costs for heating and cooling.

Reduces noise level from outside.

Parts of a Double-Hung Wood Window


FLASHING
DRIP CAP
EXTERIOR TRIM
CASING
STOPS
HEAD JAMB
B
SIDE JAMB
SIDE JAMB
HARDWARE
A
A
B
SILL
RAILS
STOOL
APRON
SILL

WINDOW UNIT

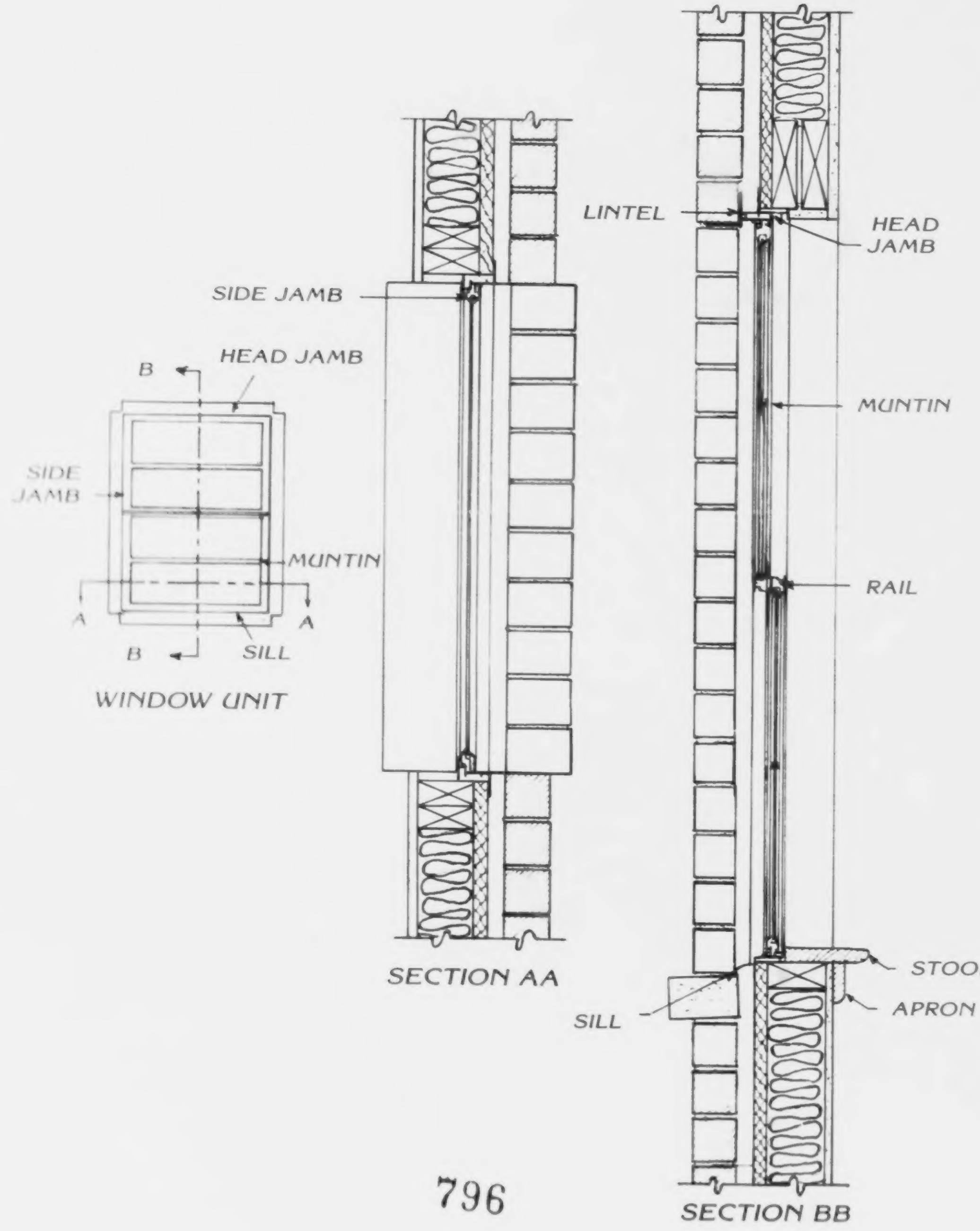
SASH

SECTION AA

SECTION BB

795

Parts of a Double-Hung Metal Window


B
HEAD JAMB
SIDE JAMB
MUNTIN
A
A
B
SILL
WINDOW UNIT
SIDE JAMB
SECTION AA
LINTEL
HEAD JAMB
MUNTIN
RAIL
STOOL
SILL
APRON
SECTION BB

WINDOWS
UNIT IV

INFORMATION SHEET

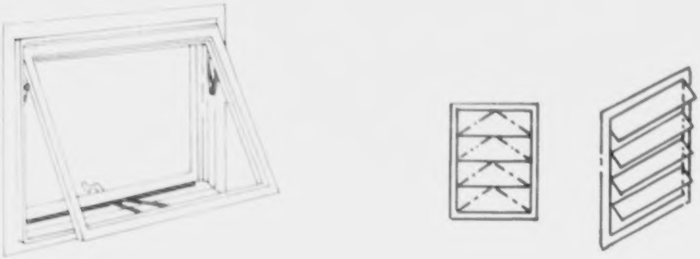
I. Descriptions of windows and accessories

A. Awning window — Has one sash hinged at the top or pivots on arms attached to the side rails; swings out at the bottom; operated by a cranking mechanism or a push bar (Figure 1)

(NOTE: Awning windows are often used for ventilation in combination with fixed windows. In representational drawings, a dotted line is used to indicate an awning window.)

EXAMPLES:

FIGURE 1

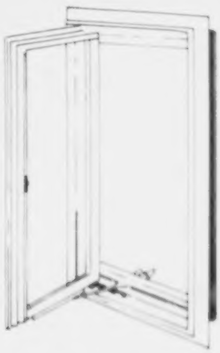


B. Casement window — Has a sash hinged on one side and swings outward; operated by a cranking mechanism or a push bar (Figure 2)

(NOTE: Two or more casement windows are often installed together.)

EXAMPLE:

FIGURE 2

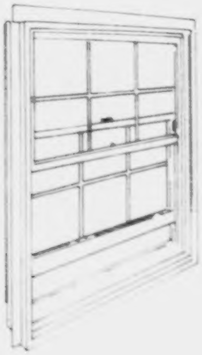


INFORMATION SHEET

C. Double-hung window — Consists of two sashes that slide up and down in a frame and are held in any given vertical position by friction-fit against frame or by springs and balancing devices (Figure 3)

EXAMPLE:

FIGURE 3

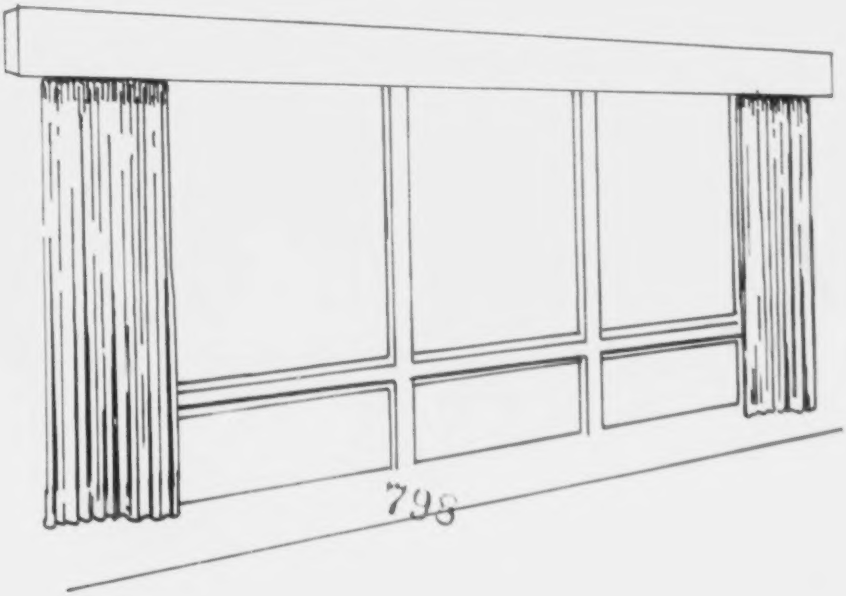


D. Fixed window — Is a nonmovable window whose main purpose is to provide daylight and a view (Figure 4)

(NOTE: This unit may be used in combination with any movable or ventilating unit.)

EXAMPLE:

FIGURE 4



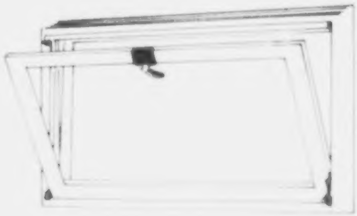
INFORMATION SHEET

E. Hopper window — Has a sash hinged along the bottom and swings inward; operated by a lock-handle located in the top rail of the sash (Figure 5)

(NOTE: Hopper windows are often combined with fixed units to provide ventilation.)

EXAMPLE:

FIGURE 5

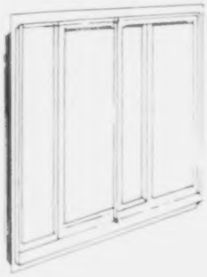


F. Horizontal sliding window — Has two or more sashes, at least one of which moves horizontally within the frame (Figure 6)

(NOTE: A horizontal sliding window may be made up of any number of sashes. The most common designs are two sashes with one or both sashes movable and three sashes with the middle sash fixed and the two outer sashes movable.)

EXAMPLE:

FIGURE 6

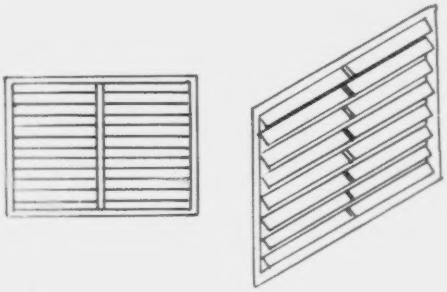


INFORMATION SHEET

G. Jalousie window — Consists of a series of horizontal glass slats in pivoted metal frames that are attached to each other by levers to operate in unison (Figure 7)

EXAMPLES:

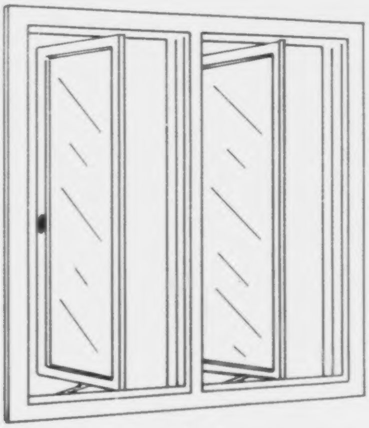
FIGURE 7



H. Multiple-use window — Has a single sash that swings outward on pivoting arms; can be installed horizontally or vertically (Figure 8)

EXAMPLE:

FIGURE 8



I. Mullion — Bar joining window units, screens, or similar frames into a single component

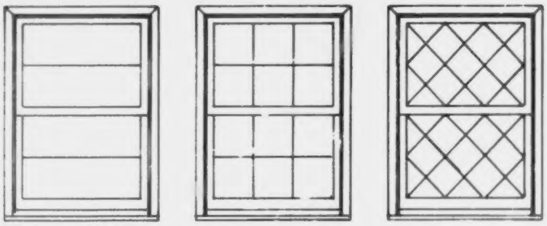
J. Muntin — Slender wood, plastic, or metal strip used to separate panes of glass within a sash (See Figure 9)

(NOTE: Muntins may actually frame panes of glass, or they may be overlays on a sheet of glass to give the appearance of smaller panes. Some muntins clip into the sash to allow removal for cleaning.)

INFORMATION SHEET

EXAMPLES:

FIGURE 9



II. Types of sliding windows

  A. Double hung

  B. Horizontal sliding

III. Types of swinging windows

  A. Casement

  B. Awning

  C. Hopper

  D. Multiple-use

  E. Jalousie

IV. Types of fixed windows

  A. Picture windows

  B. Glass block windows

  C. Window walls

V. Types of materials used to construct windows

  A. Wood (Ponderosa pine)

  B. Aluminum

  C. Steel

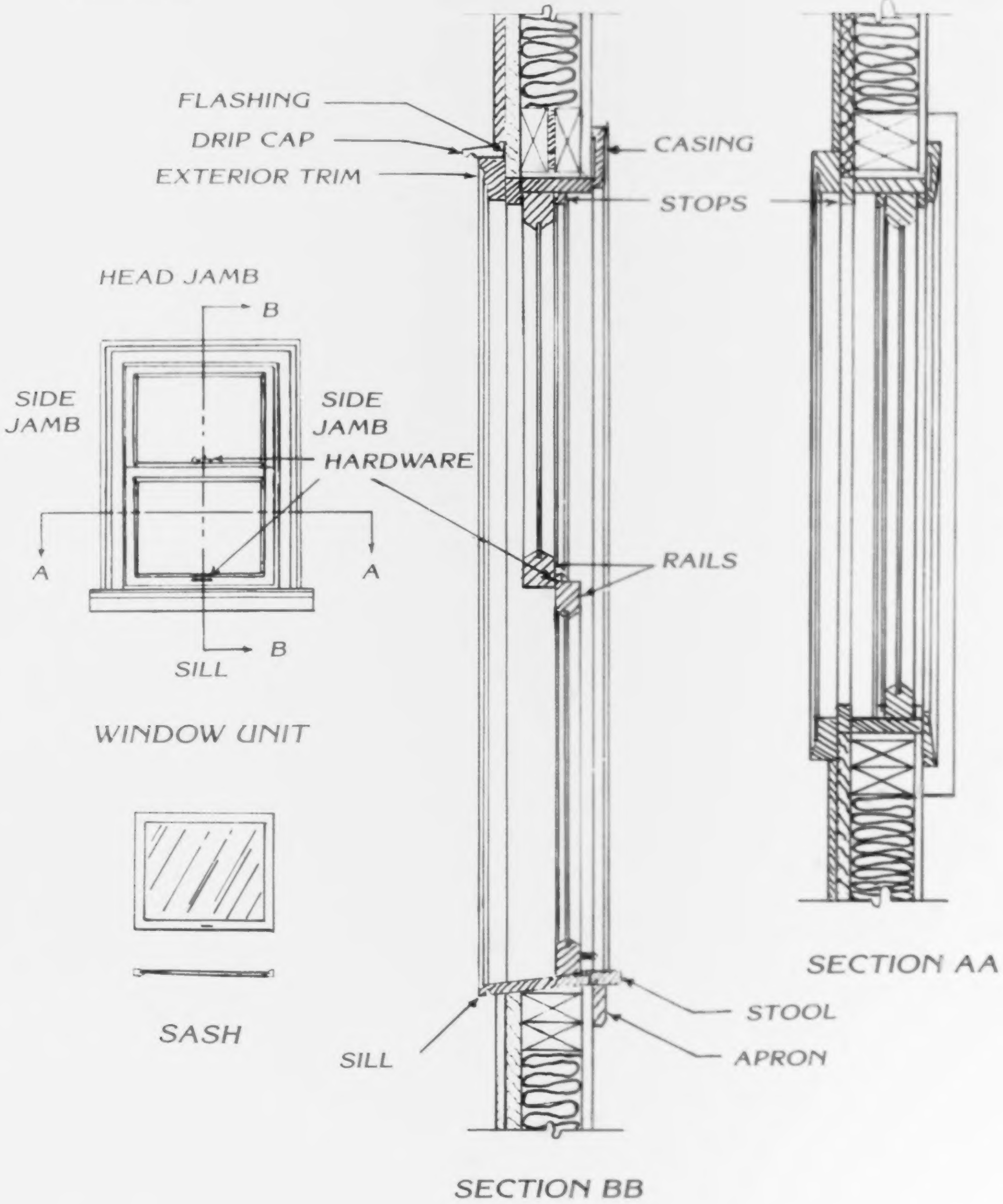
  D. Glass block

  E. Vinyl-clad wood

INFORMATION SHEET

VI. Parts of a window installation (Figure 10)

FIGURE 10


FLASHING
DRIP CAP
EXTERIOR TRIM
CASING
STOPS
HEAD JAMB
B
SIDE JAMB
SIDE JAMB
HARDWARE
A
A
RAILS
B
SILL
STOOL
SILL
APRON

WINDOW UNIT

SASH

SECTION BB

SECTION AA

INFORMATION SHEET

VII. Materials used for windowpanes

- A. Window glass
- B. Heavy sheet glass
- C. Picture glass
- D. Insulating glass panels
- E. Patterned glass
- F. Reflective glass
- G. Plastic
- H. Safety glass

  EXAMPLES: 1. Shatterproof
  2. Tempered
  3. Laminated

VIII. Information a carpenter should know when installing windows

- A. Type of window
- B. Position of window
- C. Size of each unit or combination of units

  EXAMPLES: 1. Glass size
  2. Sash size
  3. Rough frame opening

  (NOTE: Check manufacturer's specifications for rough opening size.)

  4. Unit or masonry opening

  (NOTE: This information is usually found in the window schedule; if not, the carpenter will need to study manufacturer's data and details.)

INFORMATION SHEET

IX. Recommmendations for a good window installation

- A. Follow manufacturer's recommendations and specifications
- B. Study working drawings before starting installation procedures
- C. Double-check all dimensions
- D. Use a story pole to establish height and size of rough openings
- E. Be sure rough openings are plumb, level, and correct size
- F. Do not remove diagonal braces or spacer strips until after installation
- G. If at all possible, prime window before installation
- H. Handle units carefully
- I. Be sure sashes are closed and locked in place before securing unit
- J. After temporarily nailing the unit in place, recheck entire unit to be sure it is square, level, and plumb; also check operation of the sash

WINDOWS
UNIT IV

JOB SHEET #1 — INSTALL A DOUBLE-HUNG WOOD WINDOW UNIT

I. Tools and materials

   A. Miter saw

   B. Handsaw

   C. Claw hammer

   D. Framing square

   E. Try square

   F. Folding rule or steel tape

   G. 24-inch and 48-inch levels

   H. Nail set

   I. Nails, 4d finish, 6d finish, 8d finish or casing

   J. Window unit

   K. Shingles or wood wedges

   L. Flashing or drip cap

II. Procedure

   A. Check that rough opening is plumb and level

   B. Check dimensions on rough opening and on window

   C. Install window in rough opening from the outside

   D. Use wedges or shingles under the sill to raise unit to the proper height

   E. Adjust window so it is in proper position

   F. Plumb side jambs, using shingles to hold in place

   G. Check to see that unit is in proper position, square, level, and plumb

   H. Remove bracing and check sash for smooth operation

   I. Nail window in place, using noncorrosive casing nails

   (NOTE: Space nails about 16 inches on center, and be sure they are long enough to hold the window unit sufficiently.)

JOB SHEET #1

J. Use a nail set to drive the nails the last one or two strokes (1/16 inch)

(NOTE: Using the nail set will help to keep from damaging the frame.)

K. Install flashing or drip cap above the window unit

WINDOWS
UNIT IV

TEST

NAME ______________________________ SCORE ______________

1. Match windows and accessories to their correct descriptions. Write the correct numbers in the blanks.

______a. Consists of two sashes that slide up and down in a frame and are held in any given vertical position by friction-fit against frame or by springs and balancing devices

______b. Has two or more sashes, at least one of which moves horizontally within the frame

______c. Consists of a series of horizontal glass slats in pivoted metal frames that are attached to each other by levers to operate in unison

______d. Is a nonmovable window whose main purpose is to provide daylight and a view

______e. Bar joining window units, screens or similar frames into a single component

______f. Has a sash hinged on one side and swings outward; operated by a cranking mechanism or a push bar

______g. Has a sash hinged along the bottom and swings inward; operated by a lock-handle located in the top rail of the sash

______h. Slender wood, plastic, or metal strip used to separate panes of glass within a sash

______i. Has one sash hinged at the top or pivots on arms attached to the side rails; swings out at the bottom; operated by a cranking mechanism or push bar

______j. Has a single sash that swings outward on pivoting arms; can be installed horizontally or vertically

1. Jalousie window
2. Mullion
3. Hopper window
4. Double-hung window
5. Multiple-use window
6. Muntin
7. Fixed window
8. Casement window
9. Awning window
10. Horizontal sliding window

TEST

2. Name two types of sliding windows.

a. ____

b. ____

3. Name three types of swinging windows.

a. ____

b. ____

c. ____

4. Name two types of fixed windows.

a. ____

b. ____

5. Select from the following list types of materials used to construct windows. Write an "X" in the blank before each correct answer.

_____a. Plywood

_____b. Aluminum

_____c. Glass block

_____d. Plastic

_____e. Steel

_____f. Brass

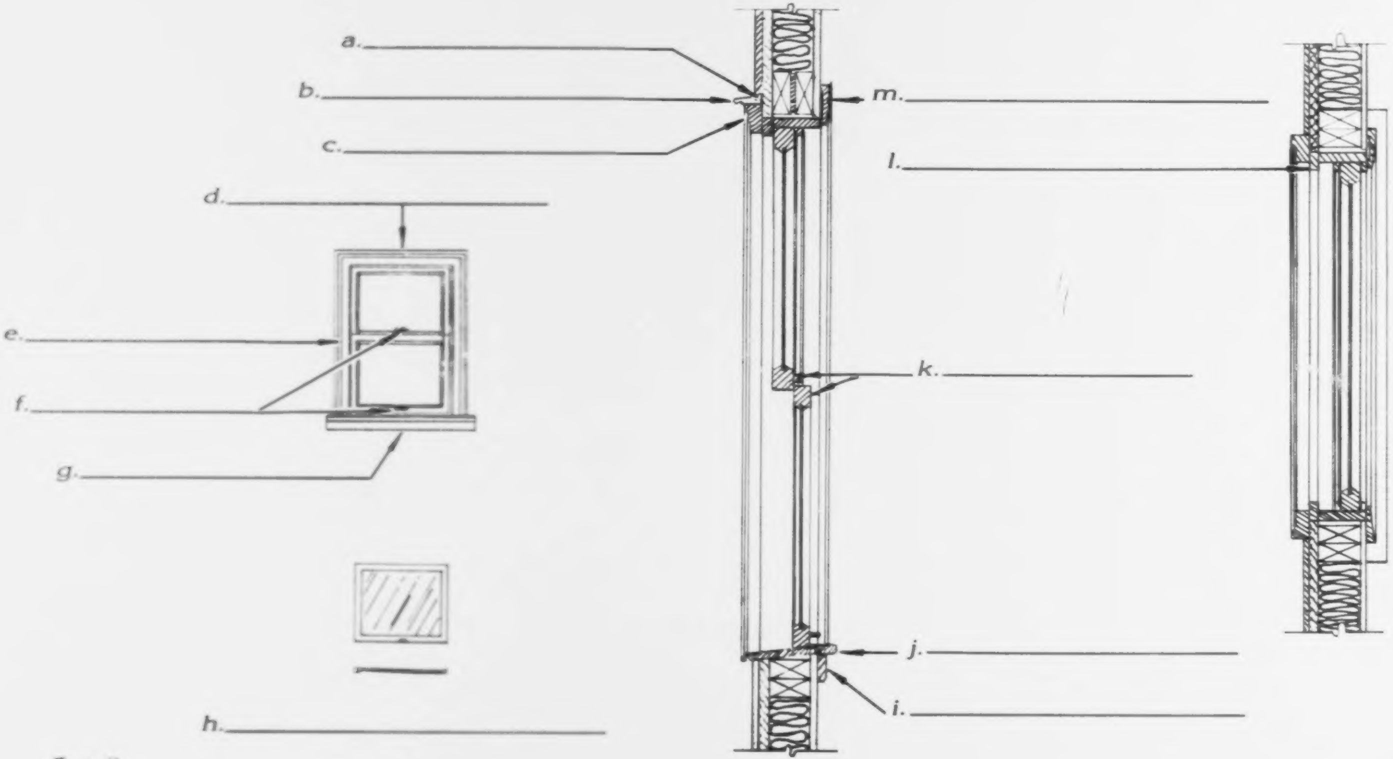
_____g. Wood (Ponderosa pine)

_____h. Vinyl-clad wood

TEST

6. Identify parts of a window installation. Write the correct names in the blanks.

Stool
Casing
Side jamb
Sash
Exterior trim
Sill
Hardware
Drip cap
Head jamb
Flashing
Rails
Stops
Apron



TEST

7. Select from the following list types of materials used for windowpanes. Write an "X" in the blank before each correct answer.

_____a. Patterned glass

_____b. Reflective glass

_____c. Bottle glass

_____d. Safety glass

_____e. Window glass

_____f. Picture glass

_____g. Windshield glass

_____h. Insulating glass panels

_____i. Rubber

_____j. Heavy sheet glass

_____k. Door glass

8. State the information a carpenter should know when installing windows.

a. ____

b. ____

c. ____

9. State five recommendations for a good window installation.

a. ____

____

b. ____

____

c. ____

____

d. ____

____

(NOTE: Test question 10 lists the job sheet. It is an important part of this test. If it has not been completed, check with your instructor.)

10. Demonstrate the ability to install a double-hung wood window unit.

WINDOWS
UNIT IV

ANSWERS TO TEST

1. a. 4
   b. 10
   c. 1
   d. 7
   e. 2
   f. 8
   g. 3
   h. 6
   i. 9
   j. 5

2. a. Double hung
   b. Horizontal sliding

3. Answer should include any three of the following
   a. Casement
   b. Awning
   c. Hopper
   d. Multiple-use
   e. Jalousie

4. Answer should include any two of the following
   a. Picture windows
   b. Glass block windows
   c. Window walls

5. b, c, e, g, h

6. a. Flashing
   b. Drip cap
   c. Exterior trim
   d. Head jamb
   e. Side jamb
   f. Hardware
   g. Sill
   h. Sash
   i. Apron
   j. Stool
   k. Rails
   l. Stops
   m. Casing

7. a, b, d, e, f, h, j

8. Answer should include
   a. Type of window
   b. Position of window
   c. Size of each unit or combination of units

ANSWERS TO TEST

9. Answer should include any five of the following
   a. Follow manufacturer's recommendations and specifications
   b. Study working drawings before starting installation procedures
   c. Double-check all dimensions
   d. Use a story pole to establish height and size of rough openings
   e. Be sure rough openings are plumb, level, and correct size
   f. Do not remove diagonal braces or spacer strips until after installation
   g. If at all possible, prime window before installation
   h. Handle units carefully
   i. Be sure sashes are closed and locked in place before securing unit
   j. After temporarily nailing unit in place, recheck entire unit to be sure it is square, level, and plumb; also check operation of the sash

10. Performance skills evaluated to the satisfaction of the instructor

EXTERIOR DOORS
UNIT V

UNIT OBJECTIVE

After completing this unit, the student should be able to install a complete entry including threshold, frame, door, hardware, trim, and weatherstripping. The student will show this knowledge by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with exterior doors to their correct definitions.
2. State basic classifications of exterior doors.
3. Identify types of entry doors.
4. Identify parts of an exterior door installation.
5. List materials used in door construction.
6. Name materials used for exterior doorsills.
7. Select from a list standard sizes of exterior doors.
8. Explain the numbering system for doors.
9. Complete statements about recommended finish clearances and dimensions for hanging doors.
10. Identify door swing (hand).
11. Identify hardware used with exterior doors.
12. List types of thresholds used with entrance doors.
13. Demonstrate the ability to
    a. Install a metal threshold on a concrete floor.
    b. Install an exterior prehung door unit.
    c. Install entry door frame, casing, door, and lock.
    d. Install weatherstripping.
    e. Install door frame and inside jambs for an overhead garage door.

EXTERIOR DOORS
UNIT V

SUGGESTED ACTIVITIES

I. Unit contents

  A. Objective sheet

  B. Suggested activities

  C. Transparency masters

    1. TM #1 — Parts of a Typical Exterior Door Installation

    2. TM #2 — Types of Entry Doors

    3. TM #3 — Types of Entries

  D. Information sheet

  E. Job sheets

    1. Job Sheet #1 — Install a Metal Threshold on a Concrete Floor

    2. Job Sheet #2 — Install an Exterior Prehung Door Unit

    3. Job Sheet #3 — Install Entry Door Frame, Casing, Door, and Lock

    4. Job Sheet #4 — Install Weatherstripping

    5. Job Sheet #5 — Install Door Frame and Inside Jambs for an Overhead Garage Door

  F. Test

  G. Answers to test

II. Instructor's guide

  A. Review unit and plan presentation.

  B. Obtain materials to supplement unit.

    1. Examples of various doors

    2. Examples of materials used in door and doorsill construction

    3. Cut-away models of various exterior doors (if possible)

    4. Door jig for demonstration purposes

    5. Samples of various types of exterior door hardware

    6. Equipment and materials for job sheet procedures

SUGGESTED ACTIVITIES

7. Transparencies and competency profiles

(NOTE: Transparencies and comp
able from the Oklahoma State
Education/Curriculum and Instru
enth Avenue, Stillwater, Oklahom
eral Contractors of America, 197
phone 202-393-2040.)

C. Provide students with unit.

D. Introduce unit.

SUGGESTIONS:

- Have students name as many exte

EXAMPLES: Entry, patio, overh
storm

- Have students name as many purp

EXAMPLES: Access, security, vi

- Use pictures from magazines and
display of exterior doors.

- Discuss the emphasis placed on
visitors; provide illustrations from
plans and specifications, discuss

- Discuss unit and specific objecti
the unit.

E. Discuss information sheet.

1. Use Information Sheet, Section
rior doors.

SUGGESTIONS:

- Show students examples of
- Use Transparency #1 or actu

2. Use Information Sheet, Section
rior doors.

SUGGESTIONS:

- Provide students with plans s

(NOTE: Be sure to emphasize the variety of applications for each type. For example, point out that a garage door may be any of the four classes.)

SUGGESTED ACTIVITIES

- Take students on a tour of the community so that they may see residences with a variety of examples of the four door classifications.

3. Use Informati[illegible]

SUGGEST[illegible]

- Use Tran[illegible]
- Obtain [illegible]
  tor's repre[illegible]
- Use cut-[illegible]
  installati[illegible]

4. Use Inform[illegible]

SUGGEST[illegible]

- Use Tran[illegible]
- Relate [illegible]
  exterior [illegible]
- Use Tran[illegible]
- Mount a [illegible]
  installation [illegible]
- Empha[illegible]
  proper [illegible]
- Discuss [illegible]
  and [illegible]
- Tour a [illegible]
  with [illegible]

5. Use [illegible]
door [illegible]

SUGG[illegible]

- Provide [illegible]
  using [illegible]
- Discuss [illegible]
  [illegible]
  [illegible]
- Empha[illegible]
  [illegible]

SUGGESTED ACTIVITIES

- Discuss local uses, costs, and availability of doors constructed of various materials; point out local codes covering exterior door construction and materials.

- Use actual doors or manufacturers' literature to point out the use of combinations of these materials.

6. Use Information Sheet, Section VII to discuss standard exterior door sizes, emphasizing local regulations governing entry door sizes.

7. Use Information Sheet, Section VIII to explain the numbering system for doors.

8. Use Information Sheet, Section IX to discuss [illegible] ances and dimensions for hanging doors.

   SUGGESTIONS:

   - Have a carpenter talk to the class about [illegible]

   - Allow students to practice measuring [illegible] with chalk on doors and frames or on [illegible] wood.

   - Demonstrate the use of a door jig and [illegible]

9. Use Information Sheet, Section X to discuss [illegible]

   SUGGESTIONS:

   - Tie in previous sections to discuss the [illegible] door.

   - Provide students with plans and have [illegible] rior doors specified in the plans. Have [illegible] and hand for prehung units.

   - Demonstrate a memory aid to help [illegible] mine door hand.

   - Demonstrate the procedures in Job Sheet [illegible]

   - Have students complete Job Sheet [illegible]

10. Use Information Sheet, Sections XI and [illegible] exterior doors and thresholds used with [illegible]

    SUGGESTIONS:

    - Provide students with samples of the [illegible] ing thresholds, and discuss their [illegible]

SUGGESTED ACTIVITIES

- Discuss weatherstripping and then demonstrate the procedures in Job Sheet #4, using various types.
- Have students complete Job Sheet #4.
- Use cut-aways to show hardware construction; demonstrate operation and installation of hardware.
- Demonstrate the procedures in Job Sheets #1, #3, and #5, emphasizing local practices and regulations and different techniques.
- Have students complete Job Sheets #1, #3, and #5.

F. Review unit.

G. Give test.

Evaluate test and discuss in class.

Complete appropriate sections of competency profiles.

References:

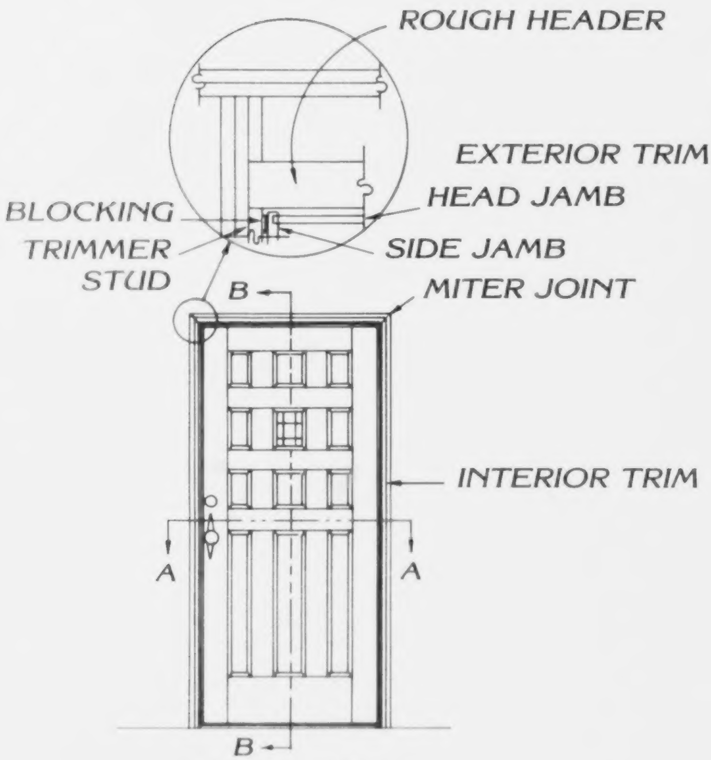
Hepler, Donald E., and Paul I. Wallach. *Architecture Drafting and Design*. 3rd ed. New York: McGraw-Hill, 1977.

Ramsey, Charles G., and Harold R. Sleeper. *Architectural Graphic Standards*. 6th ed. Edited by Joseph N. Boaz. New York: John Wiley and Sons, Inc., 1970.

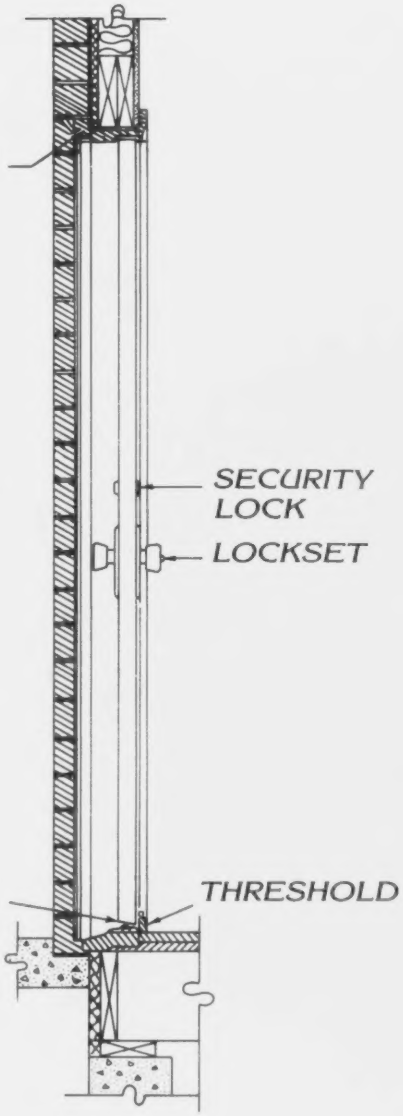
"Design a Grand Entry with Simpson," STC-1114. Seattle, Washington: Simpson Timber Company, 1982

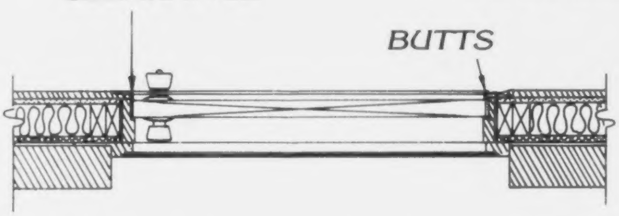
Wagner, Willis H. *Modern Carpentry*. South Holland, Illinois: The Goodheart-Willcox Co., Inc., 1976.

Parts of a Typical Exterior Door Installation


ROUGH HEADER
BLOCKING
HEAD JAMB
TRIMMER STUD
SIDE JAMB
B
MITER JOINT
INTERIOR TRIM
A
A
B

DOOR UNIT


EXTERIOR TRIM
SECURITY LOCK
LOCKSET
DOOR BEVEL
THRESHOLD


CLEARANCE
BUTTS

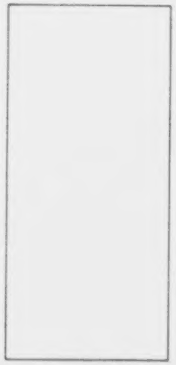
SECTION AA

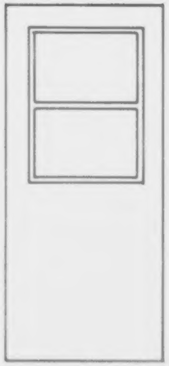
SECTION BB

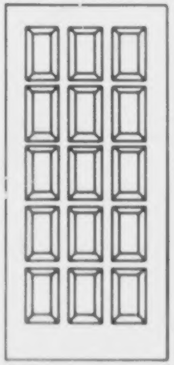
820

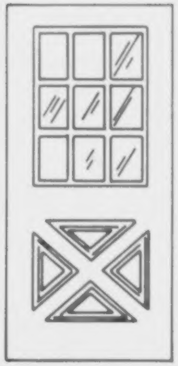
The Associated General Contractors of America

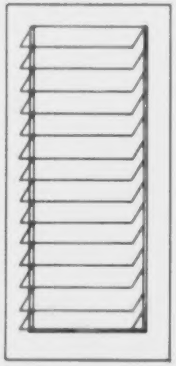
Types of Entry Doors

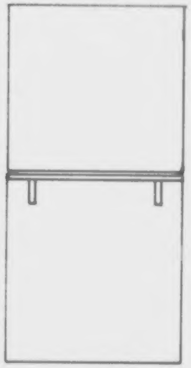

FLUSH

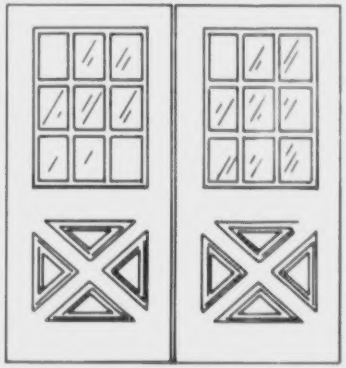

SASH


PANEL


COMBINATION


JALOUSIE

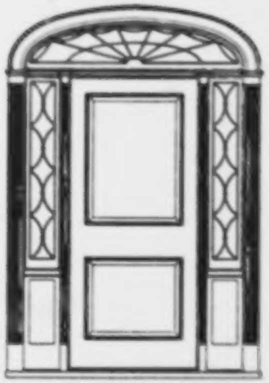

DUTCH

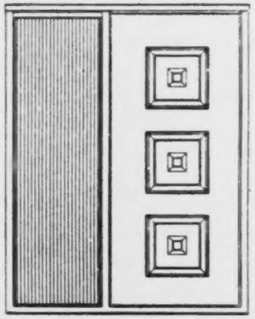

DOUBLE

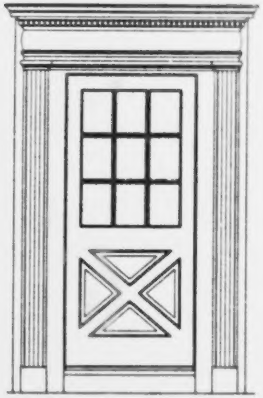
TM #2

RC - 273-E

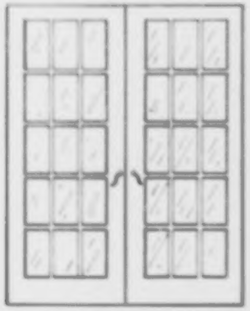
Types of Entries

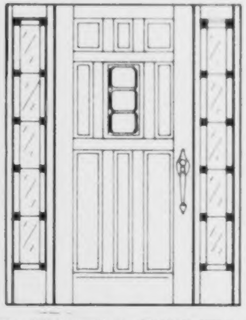

DOOR WITH
SIDELIGHTS AND FANLIGHT


DOOR WITH
SIDE PANEL (TRANSLUCENT)


DOOR WITH
ORNAMENTAL TRIM

Used with permission of Bennett Publishing Company, Peoria, Illinois, from *Carpentry and Building Construction* by John L. Feirer and Gilbert R. Hutchings, 1976.


FRENCH DOORS


DOOR WITH SIDELIGHTS

Used with permission of Simpson Timber Company, Seattle, Washington.

TM #3

RC - 275-E

EXTERIOR DOORS
UNIT V

INFORMATION SHEET

I. Terms and definitions

A. Door frame — Assembly of parts that form an enclosure and support for a door

B. Head jamb — Top door frame member that contacts door

C. Side jamb — Side door frame member that contacts door

D. Threshold — Member formed or shaped with taper on each side; used to seal space between bottom of door and sill or floor

(NOTE: Thresholds are made of a variety of materials including wood, metal, and masonry products.)

E. Reveal — Space or setback of casing or trim from edge of door or window jamb; usually 1/8 inch to 3/16 inch

F. Clearance — Space between edge of door and jambs

G. Casing — Framework of trim around windows and doors

H. Miter — Joining of two pieces of material at an angle that is one-half the total angle of junction

EXAMPLE: Two pieces that meet to form a 90-degree angle will be cut to fit at 45 degrees.

I. Rail — Horizontal frame member in a door

J. Stile — Vertical frame member in a door

K. Butt — Type of door hinge in which one leaf is mortised into edge of door and other leaf is mortised into side jamb

L. Mortise — To cut a recess into a surface to allow fit of another surface

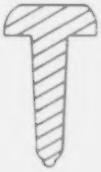
M. Jig — Device used for guiding tools or materials when performing a particular job

N. Astragal — Molding or trim attached to inside edge of one of a pair of doors to prevent door from swinging through; also used with sliding doors to ensure tighter fit where doors meet (See Figure 1)

INFORMATION SHEET

EXAMPLE:

FIGURE 1



O. Template — Gauge or pattern used as a guide to form or shape pieces being made

II. Basic classifications of exterior doors

A. Swinging

B. Sliding

C. Fixed

D. Overhead (roll-up)

III. Types of entry doors (Figures 2-8)

A. Flush

(NOTE: The surface of a flush door is smooth. However, a flush door may have a glass inset or come with decorative molding attached to the door surface.)

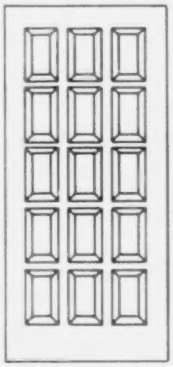
FIGURE 2

INFORMATION SHEET

B. Panel

(NOTE: Panel doors may have any number of panels. A single-panel door is generally referred to as a *plain panel door* while those with multiple panels are called *decorative panel doors*. The panels are generally square or rectangular, but also come in other shapes. Panels in metal doors are usually pressed into a single sheet of metal during manufacturing. The decorative moldings on flush doors are sometimes made to resemble panels.)

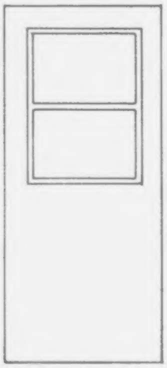
FIGURE 3



C. Sash

(NOTE: A sash door may have a fixed or movable window. The window may be divided into *lights*, such as the nine-light window shown on the combination door in Figure 5. Various types of glass are used, including insulated, reinforced, and leaded.)

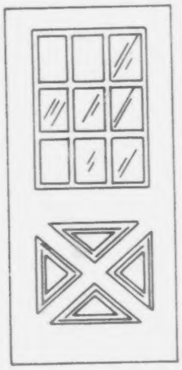
FIGURE 4



INFORMATION SHEET

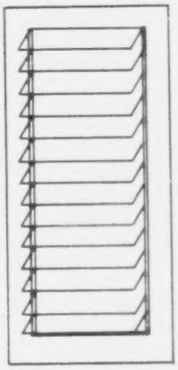
D. Combination

FIGURE 5



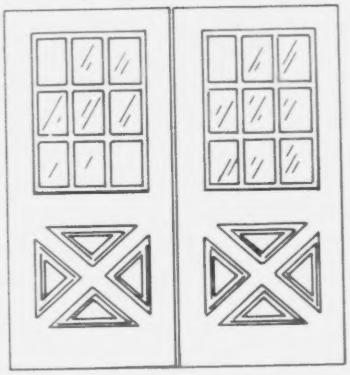
E. Jalousie

FIGURE 6



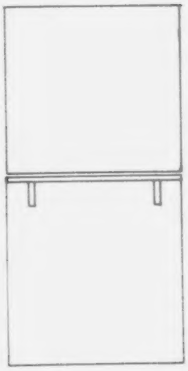
F. Double

FIGURE 7



G. Dutch

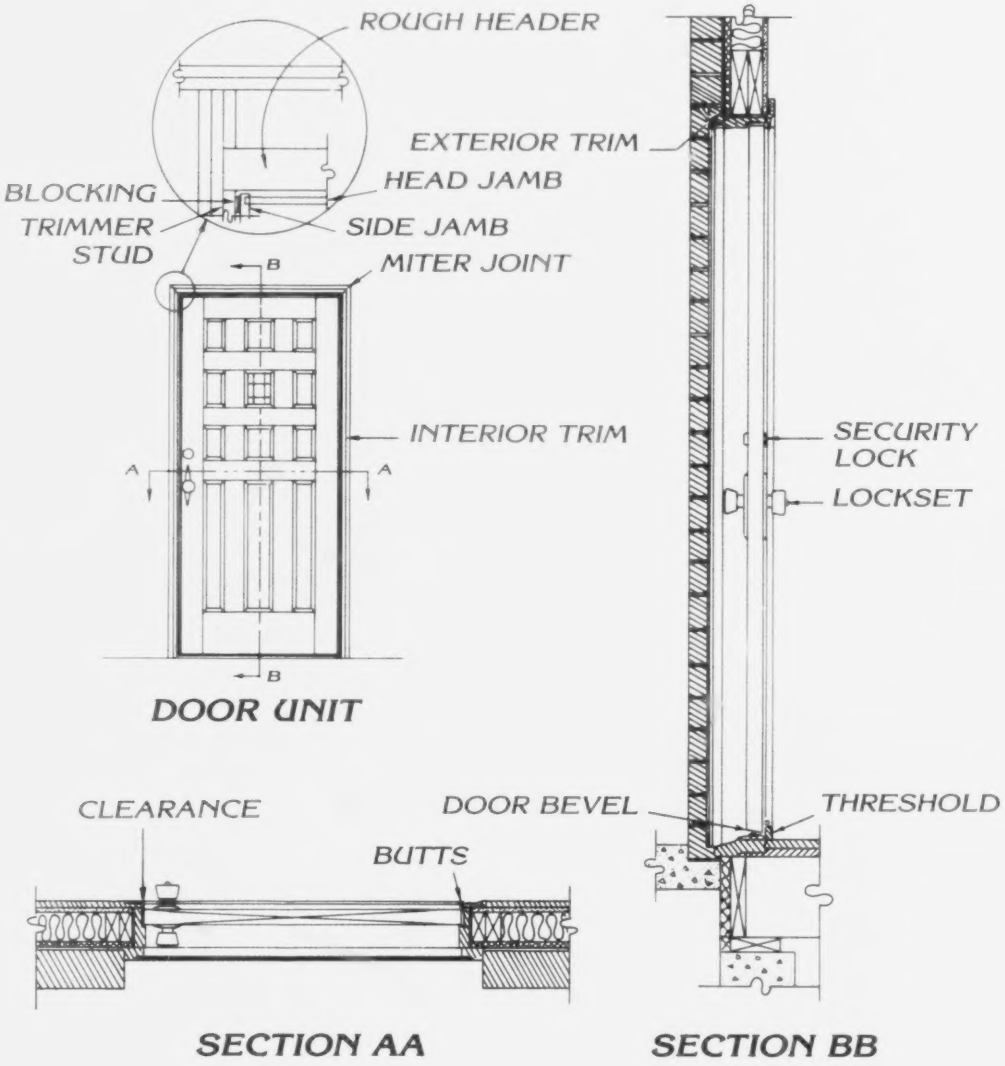
FIGURE 8



INFORMATION SHEET

IV. Parts of an exterior door installation (Figure 9)

FIGURE 9


ROUGH HEADER
EXTERIOR TRIM
HEAD JAMB
BLOCKING
TRIMMER STUD
SIDE JAMB
MITER JOINT
B
INTERIOR TRIM
A
A
B
SECURITY LOCK
LOCKSET
DOOR UNIT
CLEARANCE
BUTTS
DOOR BEVEL
THRESHOLD
SECTION AA
SECTION BB

INFORMATION SHEET

V. Materials used in door construction

A. Face

(NOTE: The face of a door may be the exposed surface of solid lumber or a veneer applied over a core. Panel doors may consist of a frame of one material with panels of another material.)

1. Plywood

   (NOTE: Plywood used in door construction may be any of a number of woods.)

2. Fiberboard
3. Plastic laminate
4. Glass
5. Solid lumber
6. Metal

   (NOTE: Steel and aluminum are the most commonly used metals in door construction.)

B. Core

(NOTE: Doors have solid cores [SC], hollow cores [HC], or implanted cores. Solid cores consist of solid lumber or fill material such as wood blocks, particle board, or foam solidly packed between wood or metal faces. Hollow cores consist of frameworks of wood strips, metal honeycombs, or other designs that give the door rigidity. Implanted cores use blocks or columns of various materials to fill most of the core. Local regulations often require the use of solid-core doors for the exterior doors of residences.)

1. Solid lumber
2. Wood blocks
3. Wood strips
4. Fiberboard
5. Volcanic minerals
6. Foam

INFORMATION SHEET

7. Polystyrene

8. Metal

VI. Materials used for [illegible]

A. Wood

B. Metal

C. Concrete

D. Stone

E. Brick

F. Marble

VII. Standard sizes of exterior doors

(NOTE: Door sizes are always given [illegible] thickness, width and height [1¾" × 2′ −8″ × 6′ −8″]. Normally [illegible] to fit the door. The width of the jamb will be the width of [illegible] clearance measured on each side. The jamb height will be the door [illegible] height of the threshold plus the top clearance. For double doors [illegible] dimension plus clearance plus thickness of astragal.)

A. 2′ −6″ × 6′ −8″

B. 2′ −8″ × 6′ −8″

C. 3′ −0″ × 6′ −8″

D. 3′ −6″ × 6′ −8″

E. 3′ −0″ × 7′ −0″

F. 3′ −6″ × 7′ −0″

VIII. Numbering system for doors

A. First two numbers indicate width in feet and inches

B. Second two numbers indicate height in feet and inches

EXAMPLE: 3/0×6/8 or 3068 or 30/68
Door is 3′ −0″ wide and 6′ −8″ high.

INFORMATION SHEET

IX. Recommended finish clearances and dimensions for hanging doors

A. Clearance

1. At top and sides, door clearance should be 3/32 inch

2. At bottom, door should be cut to minimum clearance to allow ease of operation

(NOTE: Standard bottom clearance is 5/8 inch. Where weatherstripping is used, more clearance may be necessary, depending on the type of weatherstripping used. Also, when the door swings across carpet, the clearance may need to be increased at the bottom.)

B. Dimensions

1. Top hinge should be 7 inches from top of door

2. Bottom hinge should be 11 inches from bottom of door

3. Middle hinge should be centered between other two hinges

4. Door lockset should be centered 36 inches from floor

(NOTE: If there is a lock rail on the door, the lockset should be centered on the rail.)

X. Determining the hand of a door (Figures 10-13)

(NOTE: The hand of a door—the direction in which it opens and swings—is determined by viewing the door from the outside of the building.)

A. [illegible]

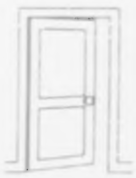
[illegible]

FIGURE 10

B. Left hand (LH)

(NOTE: Hinges are on left; door swings in.)

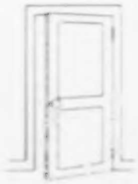
FIGURE 11



C. Right-hand reverse (RHR)

(NOTE: Hinges are on right; door swings out.)

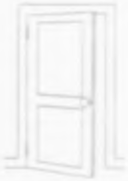
FIGURE 12



D. Left-hand reverse (LHR)

(NOTE: Hinges are on left; door swings out.)

FIGURE 13



XI. Hardware used with exterior doors

A. Standard door locks (Figures 14-17)

FIGURE 14: Mortise lock

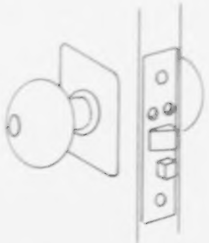


FIGURE 15: Cylindrical lock

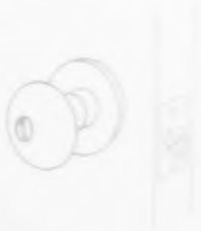


FIGURE 16: Tubular lock

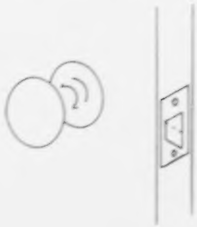
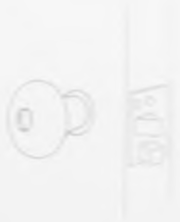


FIGURE 17: Unit lock



INFORMATION SHEET

B. Security locks (Figures 18 and 19)

FIGURE 18

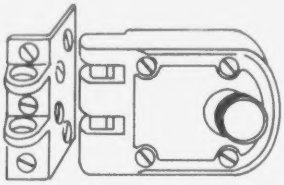
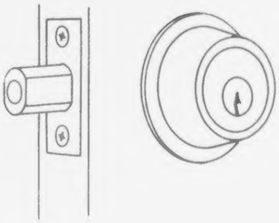
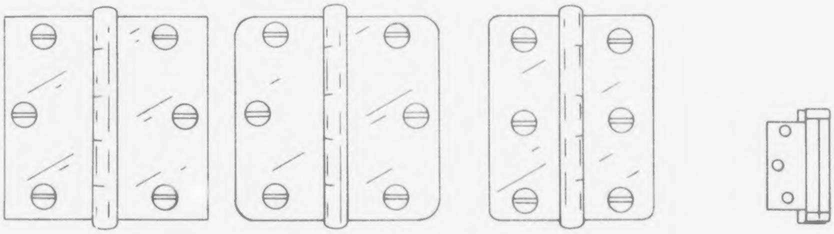


FIGURE 19



C. Door hinges (butts) (Figure 20)

FIGURE 20



Full Mortise with Square Corners

Full Mortise with Radius Corners

Half Mortise

Spring Hinge

D. Door closers (Figures 21 and 22)

FIGURE 21

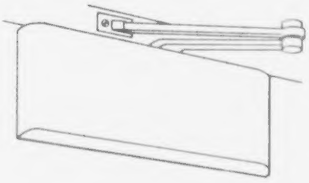
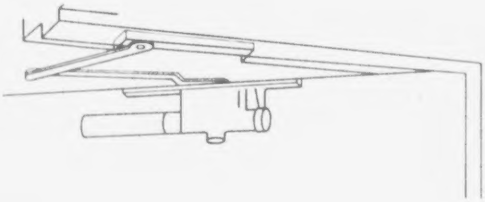


FIGURE 22



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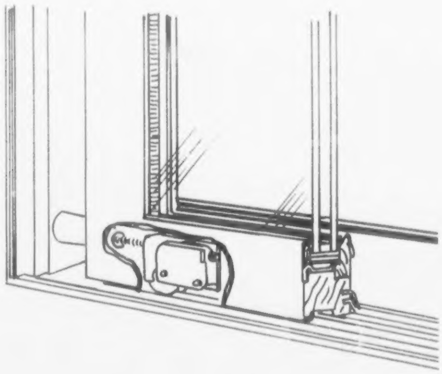
INFORMATION SHEET

E. Sliding-door hardware (Figure 23)

FIGURE 23



F. Overhead-door hardware (Figures 24 and 25)

FIGURE 24

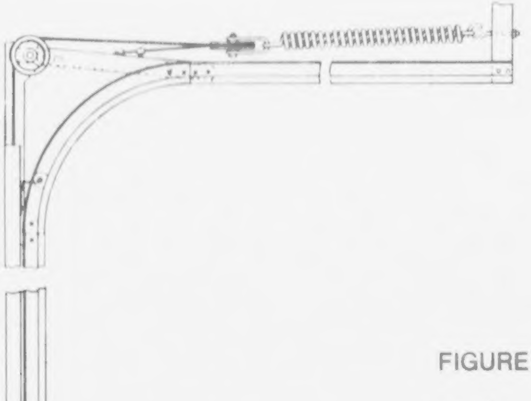
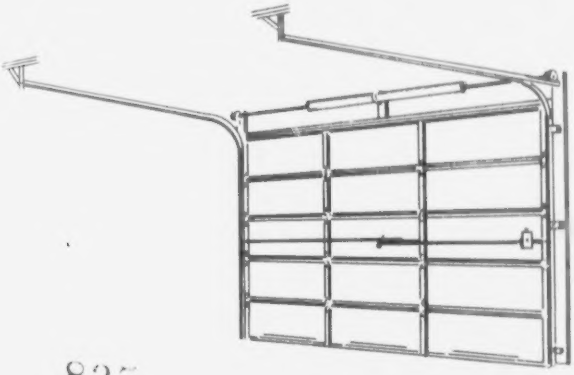


FIGURE 25



INFORMATION SHEET

G. Doorstops and bumpers (Figures 26-29)

(NOTE: The term *doorstop* also applies to the strip of molding on a doorjamb against which the door closes.)

FIGURE 26

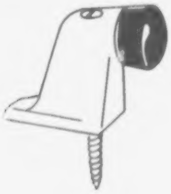


FIGURE 27

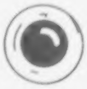


FIGURE 28

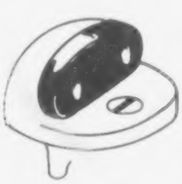
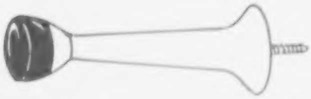
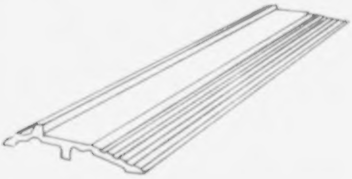


FIGURE 29



H. Thresholds (Figure 30)

FIGURE 30



I. Electric door openers (operators) (Figures 31 and 32)

FIGURE 31

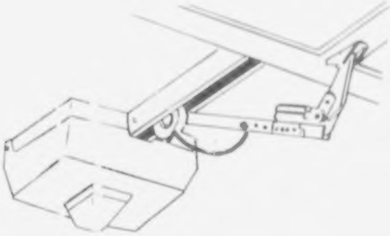
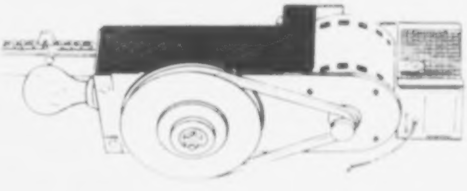


FIGURE 32



INFORMATION SHEET

XII. Types of thresholds used with entrance doors

A. Flat (Figures 33-35)

EXAMPLES:

FIGURE 33: Hardwood

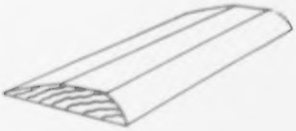


FIGURE 34: Metal

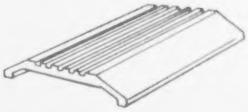
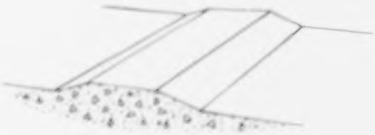


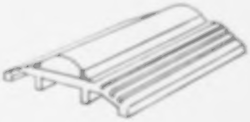
FIGURE 35: Concrete poured monolithic with floor



B. Weatherseal (Figure 36)

EXAMPLE:

FIGURE 36



EXTERIOR DOORS
UNIT V

JOB SHEET #1 — INSTALL A METAL THRESHOLD ON A CONCRETE FLOOR

I. Tools and materials

- A. Folding rule or steel tape
- B. Pencil
- C. Screwdriver
- D. Hacksaw
- E. Drill motor, masonry drills, and extension cord
- F. Hammer
- G. Metal threshold and manufacturer's installation instructions
- H. Concrete screw anchors
- I. Screws
- J. Caulking gun and caulking
- K. Eye protection

II. Procedure

- A. Read manufacturer's installation instructions
- B. Measure door opening between side jambs; transfer measurement to threshold
- C. Use hacksaw to cut threshold to length
- D. Cut opening for doorstops
    1. Measure thickness of doorstop
    2. Mark thickness of doorstop from each end of threshold along outside edge of threshold
    3. Cut along line at mark deep enough to allow for doorstop when closed door is centered over weatherseal

       (NOTE: The threshold should be positioned so that the closed door is approximately centered over the weatherseal. See Figures 37 and 38.)

JOB SHEET #1

FIGURE 37

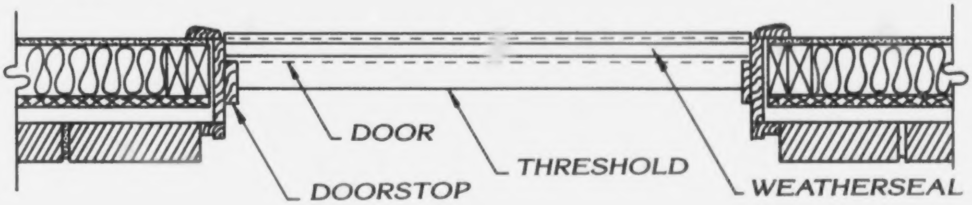
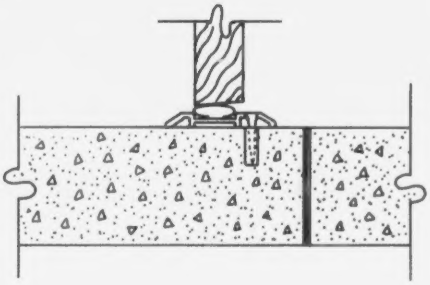


FIGURE 38



4. Cut in from each end to provide notch for doorstops

E. Place threshold in position to check for proper fit

F. With threshold in proper position, mark along each edge of threshold and through screw holes onto concrete floor

G. Remove threshold

H. Put on eye protection

I. Drill holes into concrete at each screw location, using proper drill for the anchors being used

J. Clean out each hole

K. Insert anchor in each hole and tap in place

L. Run a small bead of caulking along inside of each of the two marked lines on floor, approximately where edges of threshold will rest, and run bead of caulking material along ends of threshold

M. Press threshold into place

JOB SHEET #1

N. Start all screws, and then tighten evenly

O. Clean up caulking that may have squeezed from under threshold

P. Clean work area and return tools and materials to proper storage

EXTERIOR DOORS
UNIT V

JOB SHEET #2 — INSTALL AN EXTERIOR PREHUNG DOOR UNIT

I. Tools and materials

   A. Folding rule or steel tape

   B. 30-inch and 4-foot or 6-foot hand levels

   C. Framing and try square

   D. Claw hammer

   E. Handsaw

   F. Nail sets

   G. Caulking gun and sealer

   H. Prehung door unit and manufacturer's insutructions

   I. Wood shingles for blocking shims

   J. 16d and 8d casing nails; 4d and 6d finish nails

   K. Fiberglass insulation or sill sealer

   L. Eye protection

II. Procedure

   A. Remove crate from door unit

   B. Check unit for damage

   C. Check rough opening

      1. Check for proper dimensions

      2. Check that side jambs are plumb

      3. Check that header is level and square

      4. Check that floor is level at installation site

   D. Center unit temporarily in opening

   E. Check to see that threshold is level and that outside trim is tight against wall

   (NOTE: Use shims to level threshold if required.)

JOB SHEET #2

F. With unit in proper position, mark along inside edge of threshold

G. Remove unit from opening

H. Run a bead of caulking on floor inside marked line, approximately where edges of threshold will rest; and run a bead at jamb end locations

I. Set door unit back in center of rough opening

J. Open the door and recheck threshold for level

K. Check that header is level

L. Put on eye protection

M. Temporarily nail side jambs in place, taking care not to drive nails all the way in

N. Plumb hinge jamb by inserting shims at top of hinge jamb and just above threshold

O. Nail jamb in position through shims and into trimmer studs

P. Adjust for proper clearance by inserting shims at each hinge

Q. Nail jamb through hinge shims

(NOTE: Some carpenters like to remove one screw from each hinge and replace it with a long screw that will help anchor the jamb to the rough frame.)

R. Insert shims on lock jamb, starting at top, then moving to bottom, and then to center at strike location

S. Nail jamb to rough framing through each set of shims

(NOTE: It may be necessary to add two more sets of shims between the top and center and center and bottom in order to adjust to proper clearance.)

T. Close door and recheck for proper clearance

U. Cut off shims that may protrude outside of frame

V. Nail exterior trim, using 8d casing nails spaced about 16 inches apart

W. Fill opening between jamb and trimmer studs with fiberglass insulation or sill sealer

X. Install interior trim and lockset

Y. Adjust threshold if necessary

(NOTE: Follow manufacturer's instructions to adjust the threshold.)

Z. Clean work area and return tools and materials to proper storage

EXTERIOR DOORS
UNIT V

JOB SHEET #3 — INSTALL ENTRY DOOR FRAME, CASING, DOOR, AND LOCK

I. Tools and materials

A. Folding rule or steel tape

B. 30-inch or 78-inch hand level or jamb level

C. Framing and try square

D. Claw hammer

E. Power handsaw

F. Power planer

G. Router and door hanging kit

H. Drill motor and drills

I. Nail sets

J. Flat-blade and Phillips screwdrivers

K. Handsaw

L. Self-centering punch

M. Power miter saw or bucksaw and extension cord

N. Door jack

O. One pair sawhorses

P. Door frames ($1\frac{1}{4}$" × $4\frac{5}{8}$")

Q. Door (2′ −8″ × 6′ −8″)

R. 1×6 for door spreader

S. Door casing

T. Butt hinges

U. Cylindrical lockset with template and manufacturer's instructions

JOB SHE

- V. Wood shingles for blocking shims
- W. Nails
- X. Wood chisels
- Y. Eye protection

II. Procedure

- A. Check rough opening
  - 1. Check for proper dimensions

    (NOTE: The rough opening should be the same width as the door width plus door and jamb clearance, plus jamb thickess, plus jamb and trimmer clearance. The rough opening height should be the height of the door plus threshold thickness, top clearance, jamb thickness, and jamb and header clearance. The actual size for a 2′–8″ × 6′–8″ door is 2′–10½″ × 6′–10″.)
  - 2. Check that side jambs are plumb
  - 3. Check that header is level and square
- B. Assemble door frame, nailing side jambs to header jamb with 10d casing nails
- C. Install door frame
  - 1. Place frame in opening
  - 2. Center frame in opening, with side jambs resting on floor and inside flush with face of wall
  - 3. Place spreader on floor between side jambs

    (NOTE: The door spreader will be the same length as the header between the two side jambs.)
  - 4. Wedge frame in opening, using shims at top and bottom on both sides of frame
  - 5. Level header jamb and then temporarily secure frame to trimmer studs on both sides
  - 6. Determine swing (hand) of door and mark hinge side on frame
  - 7. Plumb hinge side of jamb by temporarily nailing shims behind hinge locations

    (NOTE: Hinges are located 7 inches down from top of door, 11 inches from bottom of door, and centered between the other two locations.)

Use straightedge or jamb level on hinge side to check frame while placing intermediate shims behind side jamb where needed

9. Recheck that hinge side of jamb is straight, plumb, and square

10. Put on eye protection

11. Use 10d casing nails to secure jamb, and then finish driving all nails into jamb

    (NOTE: Be sure that inside edges of jamb are flush with interior wall and that frame is centered in the opening.)

12. Follow same procedures to secure other side jamb

    (NOTE: Be sure to install blocking at latch location if required.)

13. Check that jambs are level, plumb, square, straight, and properly spaced

D. Install door casing

(NOTE: This procedure calls for installing the header casing first, but some carpenters prefer to install the side jambs first.)

1. Select casing

2. Establish and mark reveal near top and bottom of side jambs

3. Determine and mark length of head casing

4. Use power miter saw or bucksaw to make miter cut on both ends of head casing

5. Temporarily nail head casing in place

6. Cut miter on upper end of each side casing

7. Hold side casing in place—with miter down—and mark position for square cut on bottom of casing

   (NOTE: The position of the bottom square cut should be even with the top of the head casing.)

8. Nail side casings in place

   (NOTE: Some carpenters use glue at miters or finish the joints in some other way.)

9. Drive all nails to complete nailing pattern

   (NOTE: Use 4d or 6d finish nails along inside edge, spaced about 16 inches apart; use 8d finish nails along outside edge about 16 inches apart.)

10. Use nail set to set all exposed nailheads in casing

E. Install door

1. Check door fit in finished opening; if necessary, trim door to fit the opening

   (NOTE: Maintain a clearance of $^3/_{32}$ inch on top and both sides of door and about $^5/_8$ inch at bottom of door. Adjust bottom clearance to allow for finish flooring.)

   a. Lock door in door jack

   b. Use power planer to trim door

   CAUTION

   Make very thin cuts with power planer to avoid trimming off too much of door.

   c. Recheck door fit, repeating procedure if necessary until proper fit is obtained

2. Bevel edge of door on lock side to approximately 3 to 5 degrees

3. Lock door in door jack and position router template on hinge edge of door, with hinge template set at hinge locations

4. Set router for proper depth of cut

5. Use router to cut gains for butt hinges

6. Remove template from door

7. Install hinges on door, with tops of hinge pins toward top of door

8. Attach router template to doorjamb, positioning it to make matching cuts on jamb

9. Use router to cut gains on doorjamb

10. Remove template from doorjamb

11. Install on doorjamb free leaves of hinges

12. Remove door from door jack and hang door in place

13. Check clearance between door and doorjambs

JOB SHEET #3

F. Install door lock

(NOTE: Follow instructions and details furnished with each lock.)

1. Open door and wedge it so that it will not move
2. Measure 36 inches up from floor and mark edge of door
3. Use try square to continue this mark about 3 inches in from edge of door
4. Fold lockset template on pre-scribed line; place template on edge of door so that center lines of openings are centered on 36-inch height line
5. Mark center of the $^7/_8$-inch hole on door edge and $2^1/_8$-inch hole on face of door

   (NOTE: If boring jig is available, the template is not necessary because the jig can be adjusted for the different holes and different door thicknesses.)
6. Bore $2^1/_2$-inch hole through face of door and $^7/_8$-inch hole into edge of door
7. Use appropriate chisel to mortise for latch plate
8. Install latch unit
9. Locate, mortise, and install striker plate
10. Adjust lock for thickness of door
11. Install lock in hole, making sure that lock case hooks the retaining legs and retractor hooks the bolt tails
12. Install rose plate; insert screws and tighten
13. Install rose plate on opposite side; snap rose over retaining spring until it is tight against door
14. Align inside knob with slot on side of spindle and push knob in until it locks in place
15. Remove wedges from door
16. Close door and check to see if lock is properly installed

G. Clean work area and return tools and materials to proper storage

EXTERIOR DOORS
UNIT V

JOB SHEET #4 — INSTALL WEATHERSTRIPPING

I. Tools and materials

   A. Folding rule or steel tape

   B. Tin snips

   C. Utility knife

   D. Screwdriver

   E. ¼-inch drill motor, drill, and extension cord

   F. Weatherstripping

   G. Screws for attaching weatherstripping

   H. Pencil

   I. Eye protection

II. Procedure

   A. Cut weatherstripping to length

      1. Measure between the two side jambs on the part of header jamb that is not rabbeted or does not include doorstop

      2. Transfer measurement to weatherstripping

      3. Cut metal part of weatherstripping with tin snips; use utility knife to cut other material on a miter at both ends

      4. Measure from floor to header on part of side jambs that is not rabbeted or does not include doorstop

      5. Transfer measurements to the weatherstripping

      6. Cut weatherstripping as described above, with miter at top

   B. Install weatherstripping

      (NOTE: Weatherstripping should be attached to the center section of the frame, flush with the rabbeted edge or with the doorstop.)

      1. Position header jamb weatherstripping on jamb, with seal material flush with rabbeted edge or doorstop

JOB SHEET #4

2. Mark on doorjamb the location of screw slots or nail holes in weatherstripping

3. Put on eye protection

4. If screws are used for installation, remove weatherstripping and drill appropriate-sized hole in center of marked slots

5. Position weatherstripping back on header, and install screws or nails

   (NOTE: If weatherstripping has slots for adjustment, do not tighten the screws. Leave the weatherstripping so that, when ready, it can be slipped into proper position.)

6. Use same procedures to install weatherstripping on side jambs

7. Close door

8. For adjustable mountings

   a. Slide weatherstripping snug against door at header and tighten all screws

   b. Slide weatherstripping snug against door at side jambs and tighten all screws

9. Open door and check weatherstripping for proper position

   (NOTE: Weatherstripping should protrude over the edge approximately 1/8 inch. For proper fit, the seal should compress against the closed door.)

C. Clean work area and return tools and materials to proper storage

EXTERIOR DOORS
UNIT V

JOB SHEET #5 — INSTALL DOOR FRAME AND INSIDE JAMBS FOR AN OVERHEAD GARAGE DOOR

I. Tools and materials

- A. Folding rule and steel tape
- B. 4-foot or 6-foot hand level
- C. Framing and try square
- D. Claw hammer
- E. Power handsaw and extension cord
- F. Caulking gun and caulking
- G. One pair sawhorses
- H. 6-foot stepladder
- I. Garage door and manufacturer's specifications and details
- J. 2×7s for door frames and 2×6s for inside jambs
- K. Wood shingles for blocking shims
- L. 12d or 16d galvanized casing nails

II. Procedure

- A. Check rough opening
    1. Check for proper dimensions
    2. Check that side jambs are plumb
    3. Check that header is level and square

    (NOTE: The rough opening should be the same as the door size, plus thickness of frame, plus clearance.)

- B. Cut door frame members to size

  (NOTE: The header jamb should be the width of the door plus twice the thickness of the side jamb. The side jambs should be the same as the height of the door.)

JOB SHEET #5

C. Install finish header jamb

1. Determine height of finish header
2. Install header at desired height, flush with interior wall
3. Use shingles to shim header level
4. Nail header in place and check for level

D. Install finish side jambs

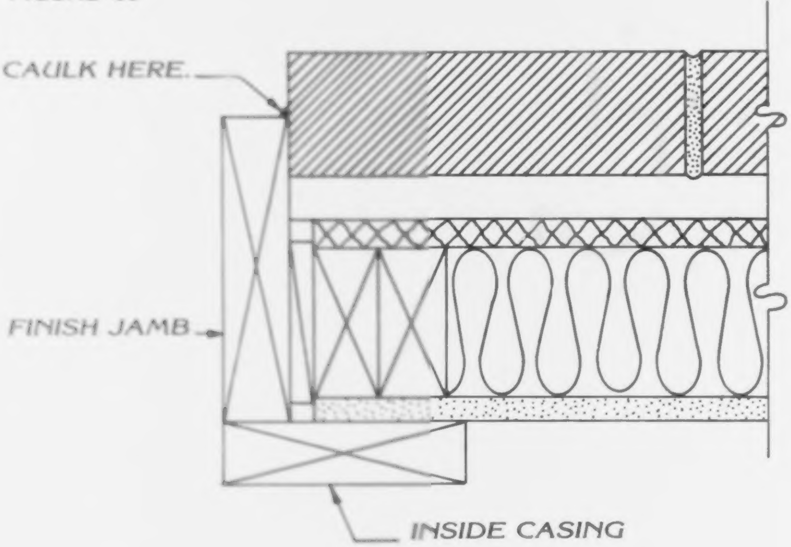
1. Install first side jamb flush with interior wall
2. Use shingles to shim jamb plumb and square
3. Nail jamb in place and check for plumb and square
4. Install second side jamb in same manner
5. Check finish opening to see that it is size of garage door

E. Cut and install inside casing and track-mounting supports

(NOTE: The inside side casing is installed full length between the floor and ceiling.)

1. Measure distance between floor and ceiling and cut side casing to this length
2. Install side casing flush with the face of finish frame (Figure 39)

FIGURE 39



JOB SHEET #5

   3. Cut and install inside header casing between two side casings and flush with face of finish header

   4. Cut and install center vertical mounting support between inside header casing and ceiling

F. Caulk outside of finish door frame between frame and brick if used

(NOTE: Doorstops will be furnished and installed by the door hanger.)

G. Check work for level, plumb, and square

H. Clean work area and return tools and materials to proper storage

RC - 309-E

EXTERIOR DOORS
UNIT V

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with exterior doors to their correct definitions. Write the correct numbers in the blanks. Definitions continue on the next page.

_____a. Space between edge of door and jambs

_____b. Gauge or pattern used as a guide to form or shape pieces being made

_____c. Type of door hinge in which one leaf is mortised into edge of door and other leaf is mortised into side jamb

_____d. Top door frame member that contacts door

_____e. Vertical frame member in a door

_____f. Molding or trim attached to inside edge of one of a pair of doors to prevent door from swinging through; also used with sliding doors to ensure tighter fit where doors meet

_____g. Space or setback of casing or trim from edge of door or window jamb; usually $^1/_8$ inch to $^3/_{16}$ inch

_____h. Assembly of parts that form an enclosure and support for a door

_____i. To cut a recess into a surface to allow fit of another surface

_____j. Joining of two pieces of material at an angle that is one-half the total angle of junction

_____k. Side door frame member that contacts door

_____l. Framework of trim around windows and doors

_____m. Member formed or shaped with taper on each side; used to seal space between bottom of door and sill or floor

1. Casing
2. Door frame
3. Side jamb
4. Template
5. Reveal
6. Threshold
7. Head jamb
8. Jig
9. Miter
10. Clearance
11. Astragal
12. Butt
13. Rail
14. Mortise
15. Stile

TEST

______n. Horizontal frame member in a door

______o. Device used for guiding tools or materials when performing a particular job

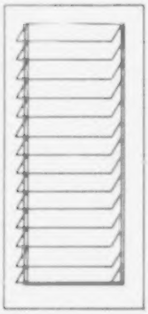
2. State two basic classifications of exterior doors.

a. ____

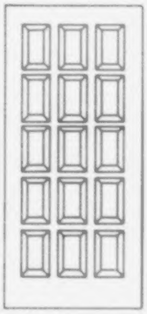
b. ____

3. Identify the following types of entry doors. Write the correct names in the blanks.

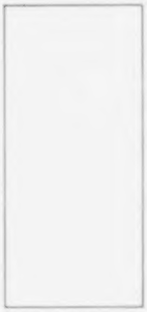
Double **Combination** **Panel** **Dutch** **Flush** **Jalousie** **Sash**



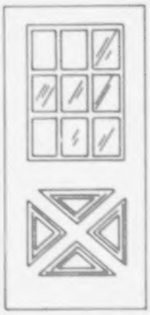
a.______________



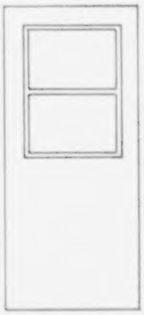
b.______________



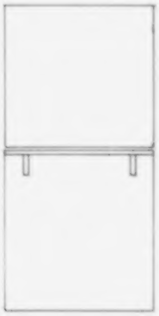
c.______________



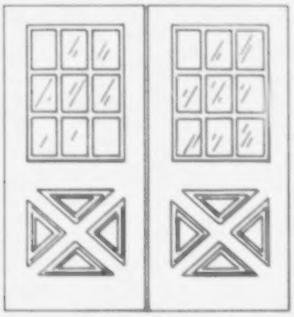
d.______________



e.______________



f.______________

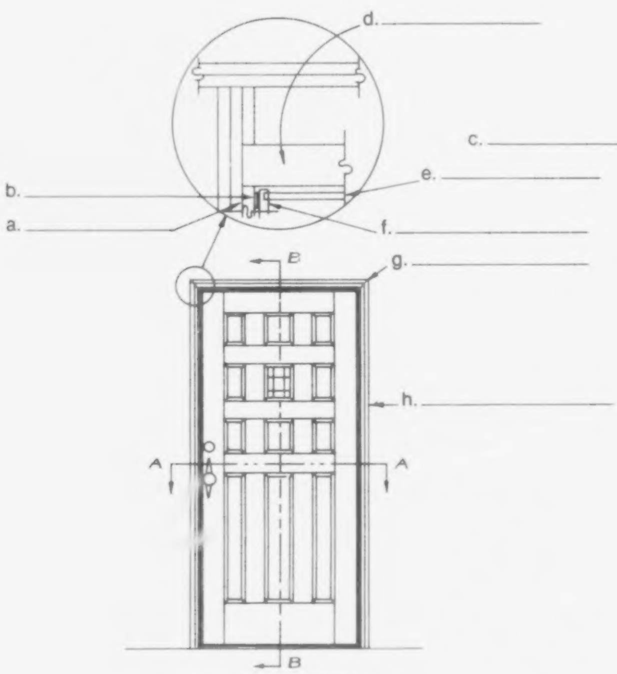


g.______________

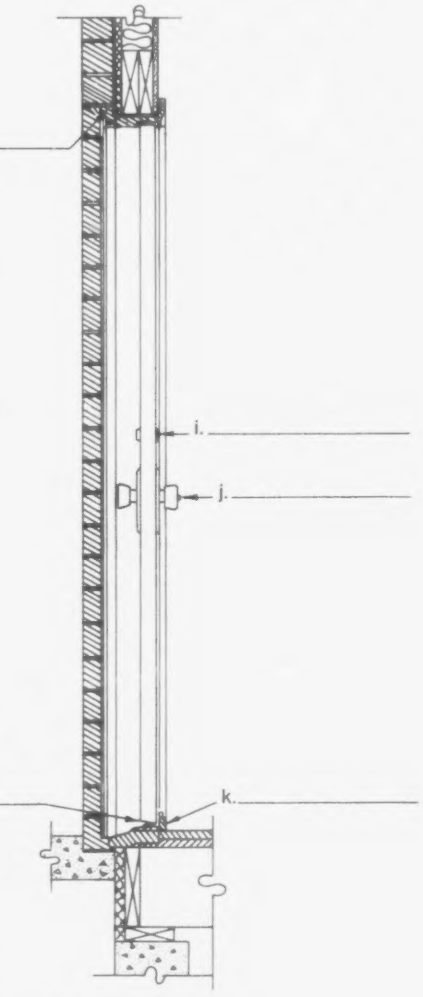
TEST

4. Identify the parts of the exterior door installation illustrated below. Write the correct names in the blanks.

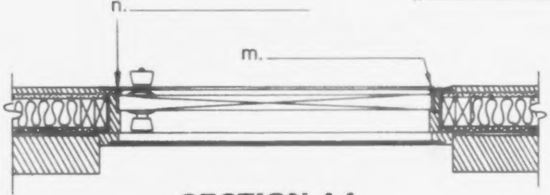
Door bevel
Trimmer stud
Security lock
Side jamb
Blocking
Interior trim
Head jamb
Exterior trim
Miter joint
Clearance
Rough header
Lockset
Butts
Threshold



DOOR UNIT



SECTION BB



SECTION AA

TEST

5. List materials used in door construction.

Face (List three.)

a. ____

b. ____

c. ____

Core (List three.)

a. ____

b. ____

c. ____

6. Name three materials used for exterior doorsills.

a. ____

b. ____

c. ____

7. Select from the following list standard sizes of exterior doors. Write an "X" in the blank before each correct size.

______ a. 2′-6″ × 6′-8″

______ b. 2′-6″ × 6′-10″

______ c. 2′-6″ × 7′-0″

______ d. 2′-8″ × 6′-8″

______ e. 2′-8″ × 6′-10″

______ f. 2′-8″ × 7′-0″

______ g. 3′-0″ × 6′-8″

______ h. 3′-0″ × 6′-10″

______ i. 3′-0″ × 7′-0″

______ j. 3′-6″ × 6′-8″

______ k. 3′-6″ × 6′-10″

______ l. 3′-6″ × 7′-0″

8. Explain the numbering system for doors.

a. ____

b. ____

TEST

9. Complete statements about the recommended clearances and dimensions for hanging doors. Write the correct answers in the blanks provided.

Clearance

a. At ____________ and ____________, door clearance should be 3/32 inch

b. At ____________, door should be cut to minimum clearance to allow ease of operation

Dimensions

a. Top hinge should be ____________ inches from top of door

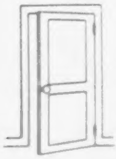
b. Bottom hinge should be ____________ inches from bottom of door

c. Middle hinge should be centered between ____________ ____________ ____________

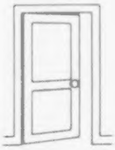
d. Door lockset should be centered ____________ inches from floor

10. Identify door swing (hand) of the doors illustrated below. Write the correct names in the blanks.

Right hand (RH) **Left hand (LH)** **Left-hand reverse (LHR)** **Right-hand reverse (RHR)**



a. ______________________________



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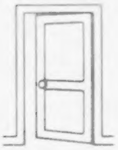

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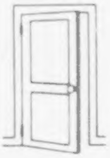
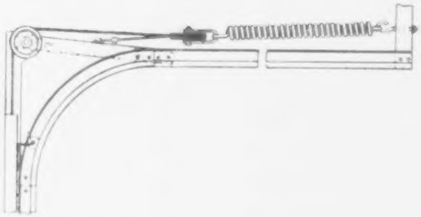


d. ______________________________

TEST

11. Identify the following illustrations of exterior door hardware. Write the correct names in the blanks. Some answers will be used more than once.

Door closer
Security lock
Sliding-door hardware
Overhead-door hardware
Threshold
Doorstop
Standard door lock
Electric door opener (operator)
Door hinge (butt)



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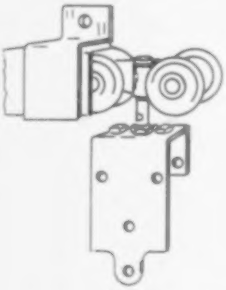
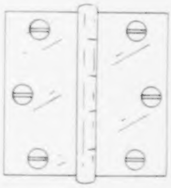
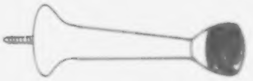


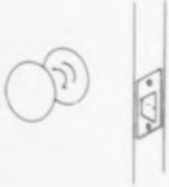
b. ______________________



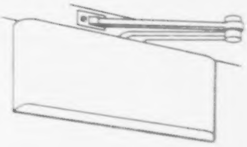
c. ______________________



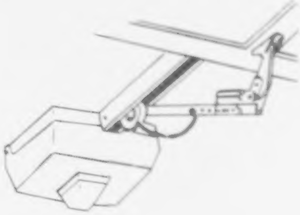
d. ______________________



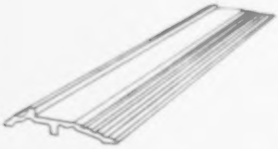
e. ______________________



f. ______________________

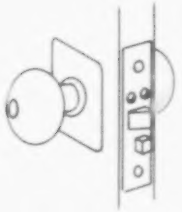


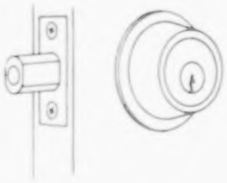
g. ______________________



h. ______________________

TEST





i. ______________________________ j. ______________________________

12. List types of thresholds used with entrance doors.

    a. ____

    b. ____

(NOTE: Test question 13 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

13. Demonstrate the ability to

    a. Install a metal threshold on a concrete floor.

    b. Install an exterior prehung door unit.

    c. Install entry door frame, casing, door, and lock.

    d. Install weatherstripping.

    e. Install door frame and inside jambs for an overhead garage door.

EXTERIOR DOORS
UNIT V

ANSWERS TO TEST

1. a. 10
   b. 4
   c. 12
   d. 7
   e. 15
   f. 11
   g. 5
   h. 2
   i. 14
   j. 9
   k. 3
   l. 1
   m. 6
   n. 13
   o. 8

2. Answer should include any two of the following

   a. Swinging
   b. Sliding
   c. Fixed
   d. Overhead (roll-up)

3. a. Jalousie
   b. Panel
   c. Flush
   d. Combination
   e. Sash
   f. Dutch
   g. Double

4. a. Trimmer stud
   b. Blocking
   c. Exterior trim
   d. Rough header
   e. Head jamb
   f. Side jamb
   g. Miter joint
   h. Interior trim
   i. Security lock
   j. Lockset
   k. Threshold
   l. Door bevel
   m. Butts
   n. Clearance

5. Answer should include any three of the following in each group

   Face
   a. Plywood
   b. Fiberboard
   c. Plastic laminate
   d. Glass
   e. Solid lumber
   f. Metal

   Core
   a. Solid lumber
   b. Wood blocks
   c. Wood strips
   d. Fiberboard
   e. Volcanic minerals
   f. Foam
   g. Polystyrene
   h. Metal

ANSWERS TO TEST

6. Answer should include any three of the following
   - a. Wood
   - b. Metal
   - c. Concrete
   - d. Stone
   - e. Brick
   - f. Marble

7. a, d, g, i, j, l

8. Explanation should include the following
   - a. First two numbers indicate width in feet and inches
   - b. Second two numbers indicate height in feet and inches

9. **Clearance**
   - a. Top, sides
   - b. Bottom

   Dimensions
   - a. 7
   - b. 11
   - c. Other two hinges
   - d. 36

10.
   - a. Right-hand reverse (RHR)
   - b. Left hand (LH)
   - c. Right hand (RH)
   - d. Left-hand reverse (LHR)

11.
   - a. Overhead-door hardware
   - b. Sliding-door hardware
   - c. Door hinge (butt)
   - d. Doorstop
   - e. Standard door lock
   - f. Door closer
   - g. Electric door opener (operator)
   - h. Threshold
   - i. Standard door lock
   - j. Security lock

12.
   - a. Flat
   - b. Weatherseal

13. Performance skills evaluated to the satisfaction of the instructor

INSULATION
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to discuss types of insulation and vapor barriers and to install these materials. The student will show this knowledge by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with insulation to their correct definitions.
2. Explain the functions of the two basic kinds of insulation.
3. Select from a list benefits of using insulation in a structure.
4. List types of insulation commonly used in residential construction.
5. Name general classifications of insulation materials.
6. List areas where insulation should be used in residential construction.
7. List factors that determine the amount of insulation needed for walls, ceilings, and floors.
8. Name types of materials used for vapor barriers.
9. Select from a list methods used to apply insulation and vapor barriers.
10. Estimate the packages of insulation needed to insulate a structure.
11. Demonstrate the ability to
    a. Install vapor barrier and insulation for a concrete slab.
    b. Install blanket insulation in walls.

INSULATION
UNIT I

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Supplements

      1. Supplement #1 — Average Low Temperatures in the United States

      2. Supplement #2 — R-Values per Inch for Various Types of Insulation

      3. Supplement #3 — Insulation Materials

      4. Supplement #4 — Insulation R-Values Required to Meet Comfort Standards

   D. Transparency masters

      1. TM #1 — Installation Methods

      2. TM #2 — Installation Methods (Continued)

      3. TM #3 — Installation Methods (Continued)

   E. Information sheet

   F. Assignment Sheet #1 — Estimate Insulation Materials

   G. Answers to assignment sheet

   H. Job sheets

      1. Job Sheet #1 — Install Vapor Barrier and Insulation for a Concrete Slab

      2. Job Sheet #2 — Install Blanket Insulation in Walls

   I. Test

   J. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

SUGGESTED ACTIVITIES

B. Obtain materials to supplement unit.

  1. Ear plugs, thermometers, and a safe heat source
  2. Literature and advertisements from insulation companies or public utilities
  3. Model or cross-section of wall showing insulation
  4. Structural members that have wood rot from excessive moisture
  5. Samples of thermal and acoustical insulation
  6. Plans specifying insulation
  7. Samples of the types of insulation illustrated in the information sheet
  8. Samples of materials used for vapor barriers
  9. Transparency masters and competency profiles

  (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

C. Introduce unit.

SUGGESTIONS:

- Demonstrate the effectiveness of insulation in sound- and heat-transfer reduction with simple examples such as ear plugs, thermometers near a heat source with one protected by thermal insulation, etc.
- Discuss common uses of insulation outside construction, such as in water heaters, in refrigerators, and under the hoods of cars. Emphasize that these materials insulate against sound as well as heat.
- Display literature and advertisements from insulation companies or public utilities promoting the use of insulation.

D. Provide students with objective sheet.

E. Discuss unit and specific objectives.

F. Provide students with information, assignment, and job sheets.

SUGGESTED ACTIVITIES

G. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Section I to discuss terms associated with insulation.

   SUGGESTIONS:

   - Show the class a model or wall cross-section to clarify definitions.
   - Display an iced drink in a metal container to demonstrate condensation.
   - Show the class samples of structural members that have developed wood rot from excessive moisture.

2. Use Information Sheet, Section II to discuss the functions of the two basic types of insulation.

   SUGGESTIONS:

   - Exhibit samples of both thermal and acoustical insulation.
   - Provide the class with plans specifying each type of insulation and discuss their applications.

3. Use Information Sheet, Section III to discuss the benefits of using insulation in a structure.

   SUGGESTIONS:

   - Ask the students to read articles or literature from insulation manufacturers and distributors to expand the discussion.
   - Demonstrate the benefits listed in this section of the information sheet.

4. Use Information Sheet, Section IV to discuss types of insulation commonly used in residential construction.

   SUGGESTIONS:

   - Show the class samples of each type of insulation discussed in this section of the information sheet.
   - Have an insulation installer discuss the procedures involved in installing each type of insulation, the advantages and disadvantages of each type of insulation, and the types of insulation used in your area, especially any not covered in the information sheet.

SUGGESTED ACTIVITIES

5. Use Information Sheet, Section V to discuss general classifications of insulation materials.

   SUGGESTIONS:

   - Show the class Supplement #3 and samples of the various insulation materials discussed in this section of the information sheet.
   - Point out that all materials have some insulating value, including dead air space, and emphasize the differences in resistive values by showing the class Supplement #2.

6. Use Information Sheet, Section VI to discuss areas where insulation should be used in residential construction.

   SUGGESTIONS:

   - Take the class to visit construction sites to show them where insulation is used. Have each student make a list of the places where insulation was used.
   - Emphasize the need for insulation at any location where heat exchange is likely, and demonstrate air leaks at windows, outlets, etc. Have students compare the lists they made at the job site and add to their lists if necessary.

7. Use Information Sheet, Section VII to discuss factors that determine the amount of insulation needed for walls, ceilings, and floors.

   SUGGESTIONS:

   - Demonstrate how the three factors discussed in this section of the information sheet are interrelated.
   - Show the class Supplements #1, #2, and #4 to relate temperature and comfort level to insulation requirements.
   - Have students or groups of students to ask a utility company or other agency to perform an energy audit of their homes; each student should then prepare a report comparing the results of the energy audit to the cost of fuel and the cost of insulation.
   - Have an insulation installer talk to the class and compare the costs of insulating new construction to insulating an existing structure.

8. Use Information Sheet, Section VIII to discuss materials used for vapor barriers, providing students with samples of each material discussed in this section of the information sheet.

SUGGESTED ACTIVITIES

9. Use Information Sheet, Section IX and Transparencies #1 through #3 to discuss methods used to apply insulation and vapor barriers.

SUGGESTIONS:

- Demonstrate each method discussed in this section of the information sheet and relate each method to specific types of insulation.
- Demonstrate the procedures in Job Sheets #1 and #2.
- Have the students complete Job Sheets #1 and #2.

10. Use Information Sheet, Section X to discuss estimating the packages of insulation needed to insulate a structure.

SUGGESTIONS:

- Emphasize the types of insulation materials commonly used in your area.
- Discuss Assignment Sheet #1.
- Have students complete Assignment Sheet #1.

H. Give test.

I. Critique test and discuss in class.

J. Reteach if necessary.

K. Complete appropriate sections of competency profiles.

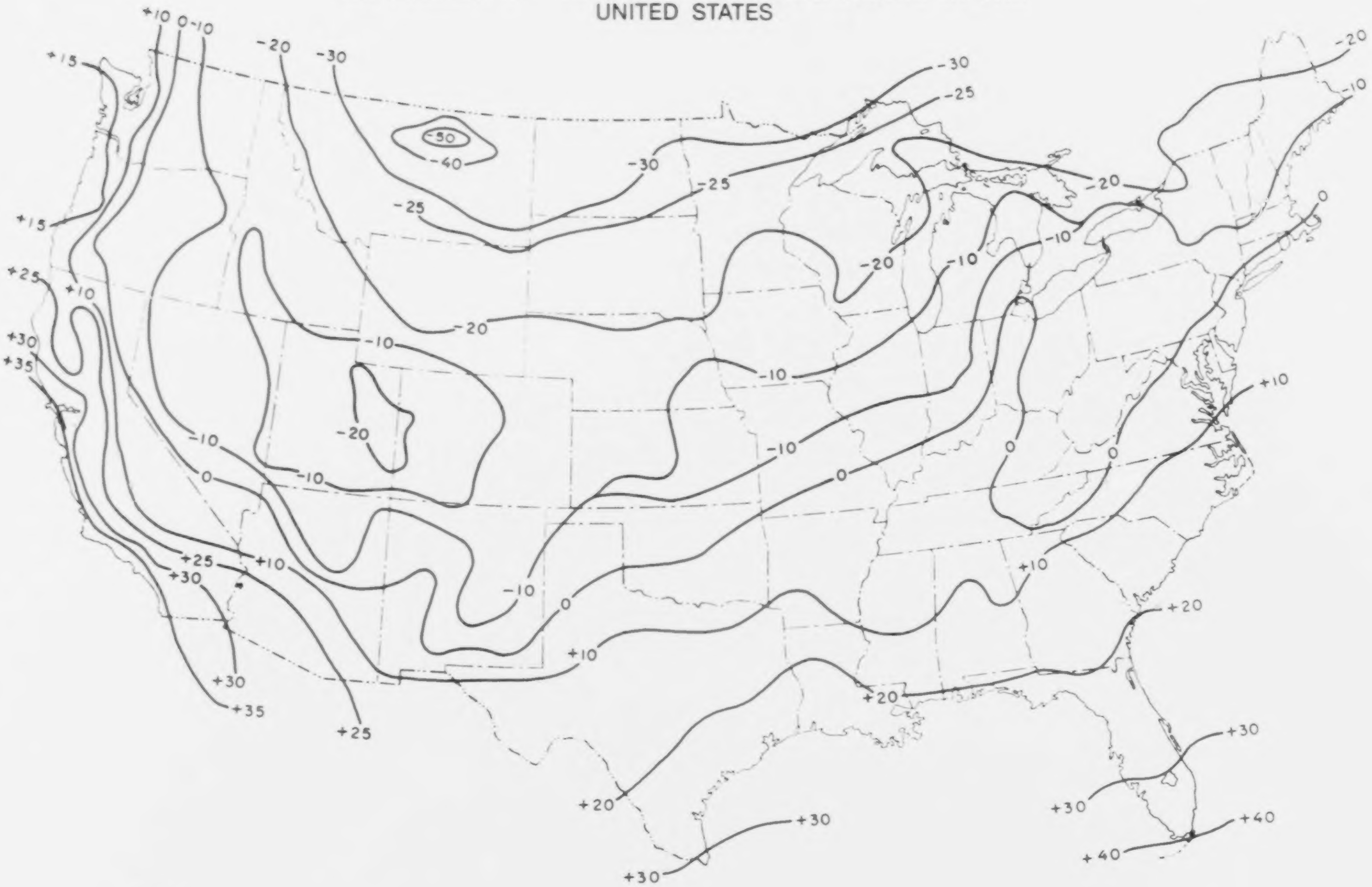
III. Unit references

A. Hepler, Donald E., and Paul I. Wallach *Architecture Drafting and Design*, 3rd ed. New York: McGraw-Hill, 1977.

B. Wagner, Willis H. *Modern Carpentry*. South Holland, Illinois: The Goodheart-Willcox Company, Inc., 1976.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — AVERAGE LOW TEMPERATURES IN THE UNITED STATES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SUGGESTED ACTIVITIES

SUPPLEMENT #2 — R-VALUES PER INCH FOR VARIOUS TYPES OF INSULATION

Material	R-Value per Inch
Polyisocyanurate	7.2
Extruded styrene	5.2
Asphalt shingles	4.8
Expanded polystyrene	4.0
Cellulose	3.8
Fiberglass (batts)	3.2
Rock wool	3.0
Fiberglass (loose fill)	2.2
Fir, pine	1.3
Glass	0.9
Brick	0.2
Cement plaster	0.2

SUGGESTED ACTIVITIES

SUPPLEMENT #3 — INSULATION MATERIALS

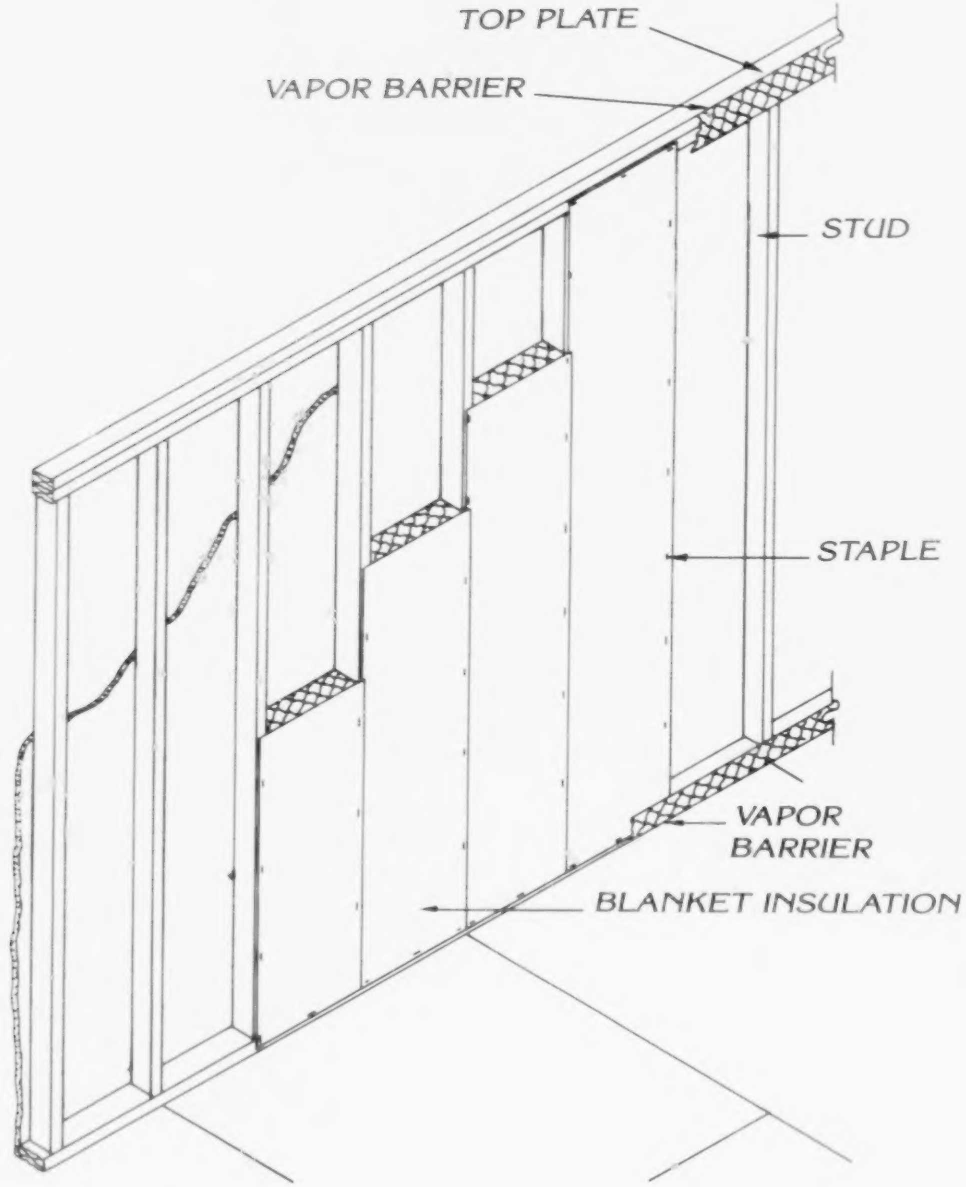
Classification	Material	Comments
Mineral	Rock Slag Glass Vermiculite	Rock and slag are used to produce "wool" by grinding and melting the materials and blowing them into a fine mass
Vegetable (natural)	Wood Sugar cane Corn stalks Cotton Cork Redwood bark Sawdust or shavings	Many vegetable products are processed and formed into various shapes, including blankets and rigid boards
Plastic	Polystyrene Rubber	—
Metal	Foil Tin plate Copper Aluminum	Metallic insulating materials are generally applied to rigid boards or papers and are used primarily for their reflective value

SUGGESTED ACTIVITIES

SUPPLEMENT #4 — INSULATION R-VALUES REQUIRED TO MEET COMFORT STANDARDS

Standard	Insulation Location	Insulation R-Value
All-weather comfort standard	Walls	R 19
	Ceilings	R 30
	Floors	R 19
Moderate comfort standard	Walls	R 13
	Ceilings	R 26
	Floors	R 13
Minimum comfort standard	Walls	R 11
	Ceilings	R 19
	Floors	R 11

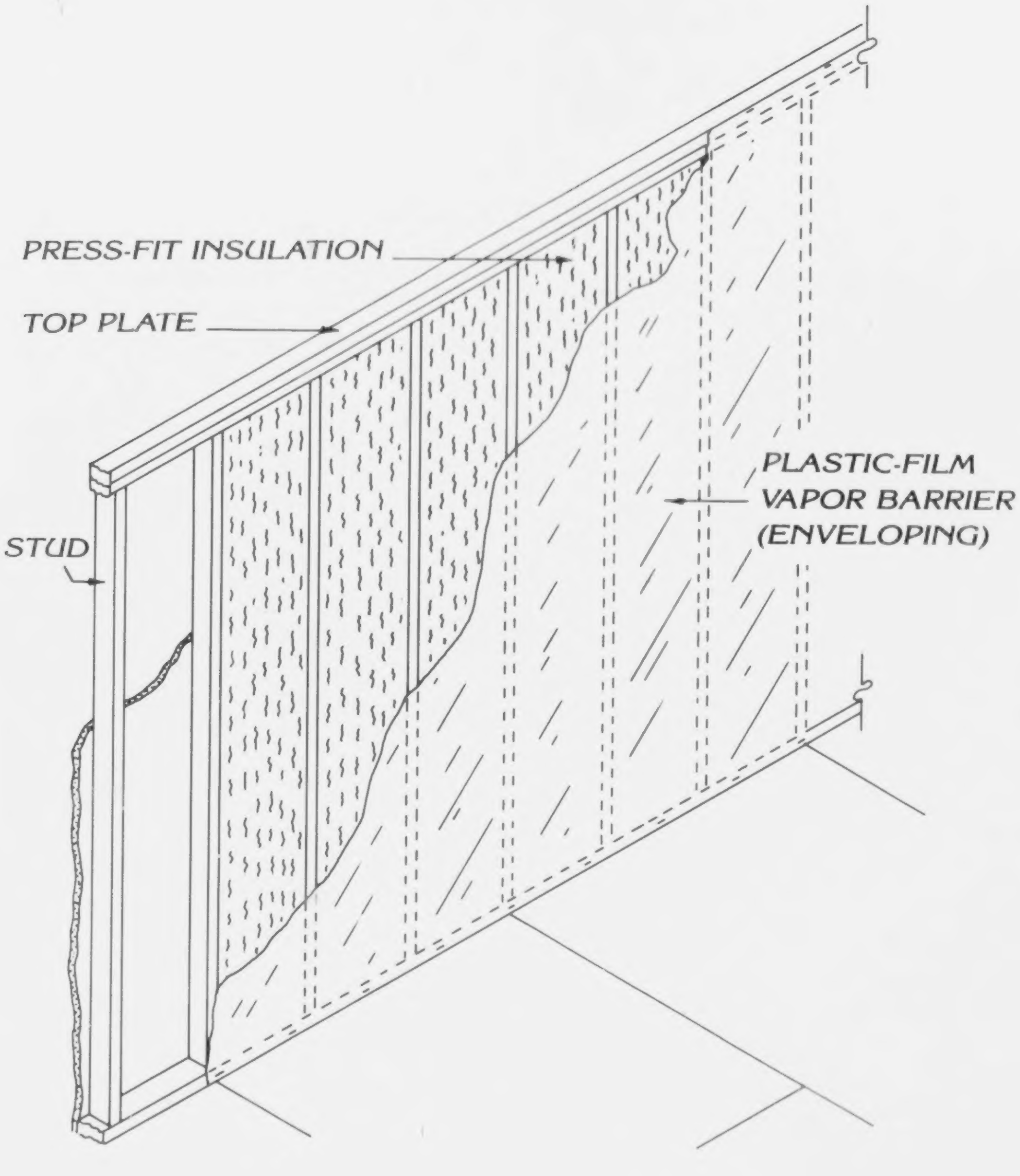
Installation Methods


TOP PLATE
VAPOR BARRIER
STUD
STAPLE
VAPOR BARRIER
BLANKET INSULATION

WALL SECTION WITH BLANKET INSULATION

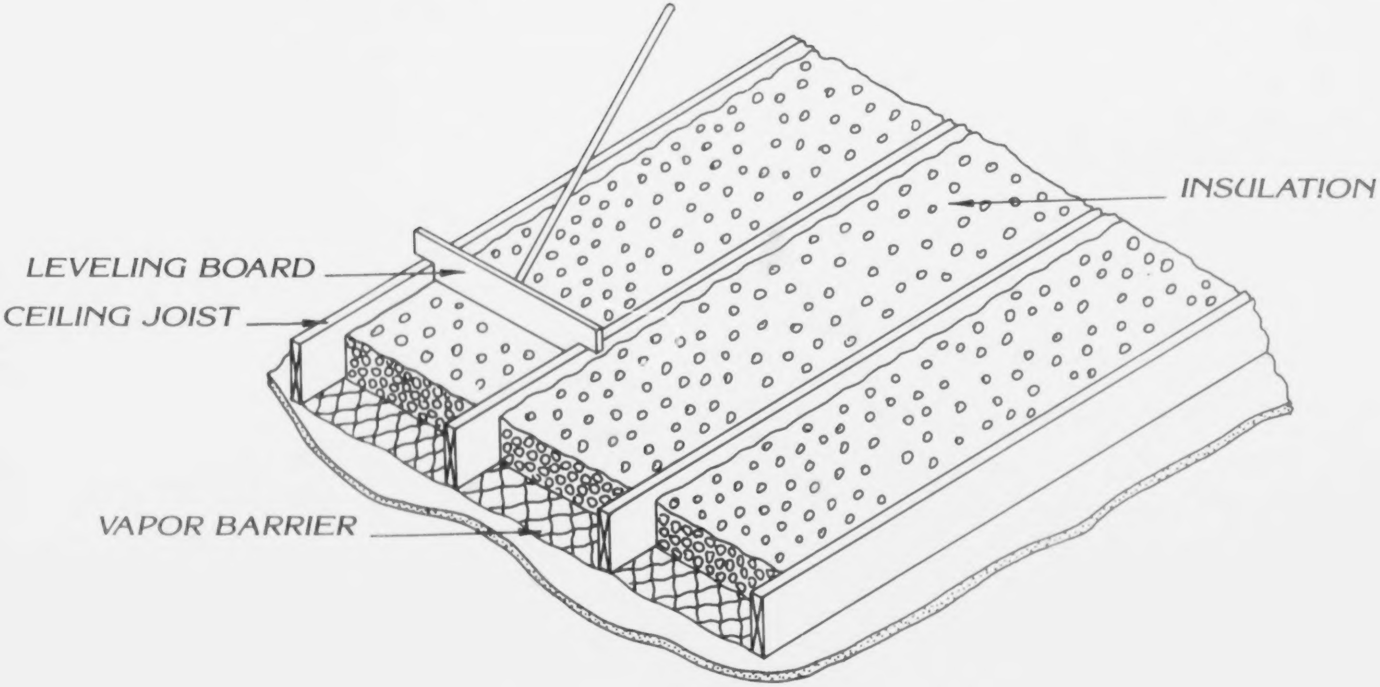
873

Installation Methods
(Continued)


PRESS-FIT INSULATION
TOP PLATE
STUD
PLASTIC-FILM
VAPOR BARRIER
(ENVELOPING)

WALL SECTION WITH PRESS-FIT INSULATION

Installation Methods
(Continued)


LEVELING BOARD
CEILING JOIST
INSULATION
VAPOR BARRIER

CEILING WITH FULL INSULATION

INSULATION
UNIT I

INFORMATION SHEET

I. Terms and definitions associated with insulation

   A. Insulation — Material used in walls, ceilings, and floors to retard the passage of heat and sound

   (NOTE: Acoustical insulation retards the passage of sound and thermal insulation retards the passage of heat.)

   B. Reflective insulation — Metal-surfaced insulating material exposed to an air space to reduce heat radiation across the air space

   C. Perimeter insulation — Insulating material installed at foundation and floor slab around perimeter of structure

   D. Condensation — Process by which vapor becomes liquid

   E. Moisture penetration — Process by which moisture moves into a structure

   F. Vapor barrier — Material that prevents the passage of moisture or vapor into or through structural elements

II. Functions of the two basic kinds of insulation

   (NOTE: Basically, two types of insulation are used in residential construction: thermal and acoustical.)

   A. Thermal insulation — Retards the transfer of heat from inside a structure to the outside and from the outside into the structure

   B. Acoustical insulation — Retards the passage of sound waves from the outside into a structure or from one room to another within the structure

III. Benefits of using insulation in a structure

   A. Prevents rapid temperature changes

   B. Reduces fuel expenses

   C. Retards or resists the spread of fire

   D. Prevents condensation

   E. Reduces noise from the outside

   F. Helps absorb echoes

INFORMATION SHEET

IV. Types of insulation commonly used in residential construction (Figures 1-10)

(NOTE: There are many types of insulation other than those listed below. Examples of other types of insulation include lightweight aggregates such as vermiculite, perlite, blast furnace slag, burned clay products, and cinders. Aggregates are commonly used in plaster and concrete to improve the insulating qualities of these materials.)

A. Flexible batt insulation

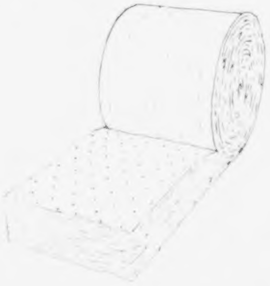
EXAMPLE:

FIGURE 1

B. Flexible blanket insulation

EXAMPLE:

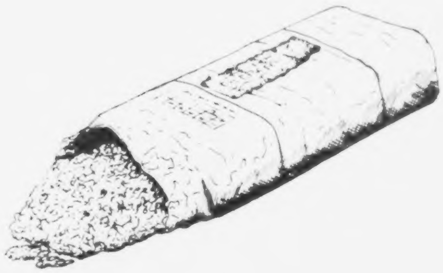
FIGURE 2



C. Loose-fill insulation

EXAMPLE:

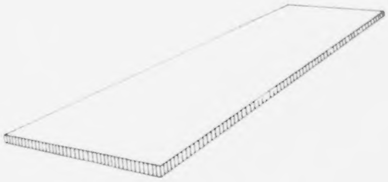
FIGURE 3



D. Rigid board insulation

EXAMPLE:

FIGURE 4

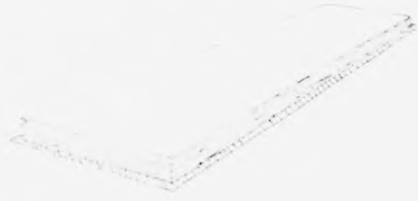


INFORMATION SHEET

E. Reflective insulation

EXAMPLE:

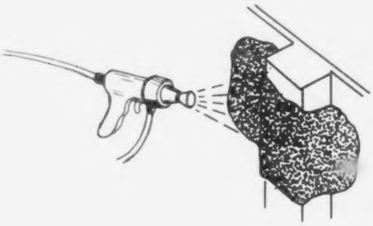
FIGURE 5



F. Adhesive-type insulation

EXAMPLE:

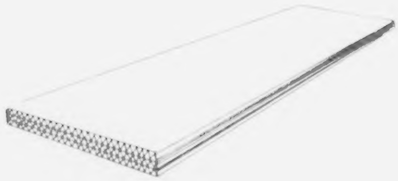
FIGURE 6



G. Corrugated-paper insulation

EXAMPLE:

FIGURE 7

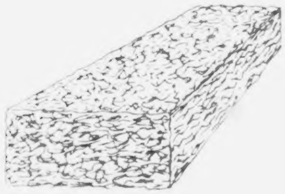


H. Friction-batt insulation

(NOTE: Friction-batt insulation is fiberglass insulation without a paper cover.)

EXAMPLE:

FIGURE 8



INFORMATION SHEET

I. Foamed-plastic insulation

EXAMPLES:

FIGURE 9: Blown-in foamed-plastic insulation

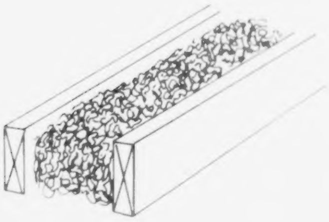


FIGURE 10: Rigid-board foamed-plastic insulation

V. General classifications of insulation materials

A. Mineral

B. Vegetable (natural)

C. Plastic

D. Metal

VI. Areas where insulation should be used in residential construction

(NOTE: In general, insulation should be used where any structural surface is exposed to thermal exchange.)

A. Over ground in crawl space

B. Around perimeter of concrete floors and foundations

C. Between floor joists

D. Between wall studs

E. Above ceilings

F. In roof structure

(NOTE: In the roof structure, the vapor barrier must always face the heated area [toward interior], and for proper air circulation, the air space must always be maintained between the insulation and the roof sheathing.)

INFORMATION SHEET

VII. Factors that determine the amount of insulation needed for walls, ceilings, and floors

A. Average low and high temperatures

(NOTE: Although the average low temperature is normally used as the basis for determining insulation requirements, the average high temperature of an area should also be considered in warm climates to prevent loss of cool inside air and penetration of hot outside air.)

B. Level of comfort desired

(NOTE: *Comfort level* refers to the inside temperature that must be maintained for personal comfort. Comfort levels are generally divided into three standards: the all-weather standard, the moderate standard, and the minimum standard. To meet the all-weather standard, the amount of insulation provided must be adequate to maintain a desired temperature even during periods of extreme outside temperatures. To meet the moderate standard, the insulation provided must be adequate to maintain a desired temperature during periods of average outside temperature extremes. And, to meet the minimum standard, the amount of insulation provided must only be adequate enough to reduce heat exchange.)

C. Cost

(NOTE: When determining the amount of insulation needed, compare the insulation cost to the cost of fuel needed to maintain a given comfort level; also include in your comparison the cost of materials and labor and the interest paid on the increased cost. Ensure that the cost of the insulation will pay for itself in terms of all these expenses.)

VIII. Materials used for vapor barriers

(NOTE: Many insulation materials and interior surface materials are backed with vapor barriers which when installed properly are usually sufficient to resist moisture penetration. The following materials are used as vapor barriers either singly or in combinations.)

A. Asphalt-coated paper

B. Aluminum foil

C. Polyethylene film

D. Roll roofing

IX. Methods used to apply insulation and vapor barriers

A. Stapled

INFORMATION SHEET

(NOTE: Insulation and vapor barriers may be stapled down with either a hand-held or pneumatic stapler.)

B. Nailed

(NOTE: Either a hammer or a pneumatic nailer may be used in nailing insulation and vapor barriers.)

C. Pressed in place and held with mastic

D. Hand-poured

(NOTE: Loose-fill material is often hand-poured.)

E. Blown in

(NOTE: Loose-fill material may be blown in place.)

F. Sprayed on

(NOTE: Adhesive-type material is sprayed on.)

G. Rolled out and taped at joints

(NOTE: When polyethylene film or roll roofing is installed, the material should be lapped at least 4 inches on all edges and should extend well up the foundation walls. Tape to seal all edges and to hold the material up on the foundation walls.)

X. Estimating packages of insulation needed to insulate a structure

(NOTE: When estimating materials, round up to the next even foot.)

A. Calculate square footage of exterior walls to be insulated

1. Determine from plans length of perimeter of each exterior wall

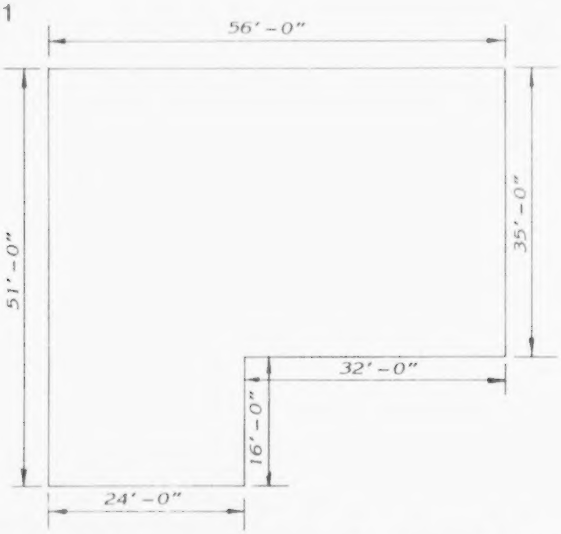
2. Add lengths of all walls to find the structure's total perimeter

EXAMPLE: If walls of a structure are 56 feet, 35 feet, 32 feet, 16 feet, 24 feet, and 51 feet (See Figure 11), then

56′ + 35′ + 32′ + 16′ + 24′ + 51′ = 214′ = Structure's Total Perimeter

INFORMATION SHEET

FIGURE 11



3. Multiply total perimeter by ceiling height to find total square footage of walls

   EXAMPLE: If the total perimeter of a structure is 214 feet and the ceiling height is 8 feet, then

   214' × 8' = 1,712 sq ft = Total Square Footage of Exterior Walls

4. Determine from plans the total square footage of each opening

5. Add the square footage of all openings to find total square footage of openings

6. Subtract total square footage of openings from total square footage of walls to find square footage of walls to be insulated

   EXAMPLE: If the total square footage of walls is 1,712 square feet and the total square footage of openings is 174 square feet, then

   1,712 sq ft − 174 sq ft = 1,538 sq ft = Square Footage of Exterior Walls to Be Insulated

B. Calculate square footage of ceilings to be insulated

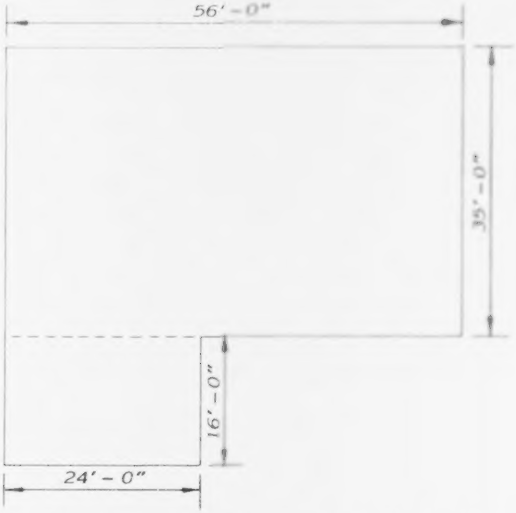
(NOTE: The square footage of floor to be insulated is the same as the square footage of ceiling to be insulated.)

1. Divide ceiling into rectangular or square areas and determine from plans the length and width of each area (See Figure 12)

INFORMATION SHEET

EXAMPLE:

FIGURE 12



2. Multiply length times width to find square footage of each ceiling area

   EXAMPLE: If there are ceiling areas of 56′ × 35′ and 24′ × 16′, then

   56′ × 35′ = 1,960 sq ft
   24′ × 16′ = 384 sq ft

3. Add the square footage of all areas to find total square footage

   EXAMPLE: If there are ceiling areas of 1,960 square feet and 384 square feet, then

   1,960 sq ft + 384 sq ft = 2,344 sq ft = Total Square Footage of Ceilings to Be Insulated

C. Calculate total square footage of area to be insulated — Add square footage of exterior walls to be insulated to square footage of ceilings

EXAMPLE: If the total square footage of exterior walls is 1,538 square feet and the total square footage of ceilings is 2,344 square feet, then

1,538 sq ft + 2,344 sq ft = 3,882 sq ft = Total Square Footage of Area to Be Insulated

INFORMATION SHEET

D. Calculate packages of insulation needed to insulate structure

1. Determine number of packages needed to cover square footage of area to be insulated

   (NOTE: Insulation packaging varies considerably with different manufacturers, types of materials, R-factors, and width and thicknesses of materials. See Table 1.)

   EXAMPLE:

TABLE 1: Coverage of Insulation in Packaging by Various Manufacturers

R-Value	Thickness	Width	Length	Total Coverage
38	12"	16"	48"	32 sq ft per pkg
38	13"	16"	48"	64 sq ft per pkg
19	6½"	15"	39½"	49 sq ft per pkg
19	6¼"	15"	94"	48.96 sq ft per pkg
19	6½"	15"	24"	120 sq ft per pkg

2. Divide square footage of area to be insulated by amount of coverage per package to find the number of packages of insulation needed

INSULATION
UNIT I

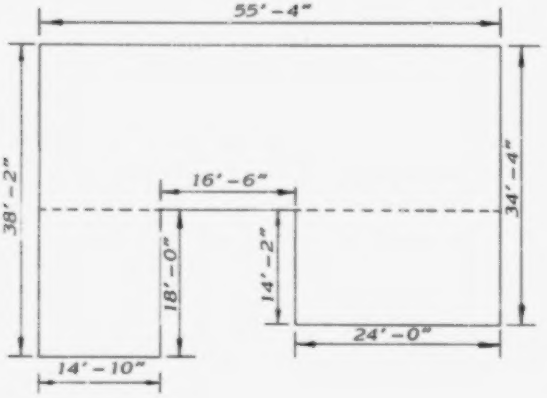
ASSIGNMENT SHEET #1 — ESTIMATE INSULATION MATERIALS

NAME ______________________________ SCORE ______________

The carpenter must practice estimating insulation materials because so many things must be considered. There are many different types of insulation materials, most of which may be applied in various forms, such as batts, loose fill, and rigid. Additionally, the amount of material required to obtain a particular R-factor must be considered as well as the most effective placement of that material.

Use the illustrations and dimensions given to estimate insulation materials needed for each application method described. Show your work.

A. Estimate wall and ceiling insulation for the structure illustrated below. Finished wall height is 8'-0" and total area of wall openings is 220 square feet.



1. Wall area to be insulated = ____________ square feet

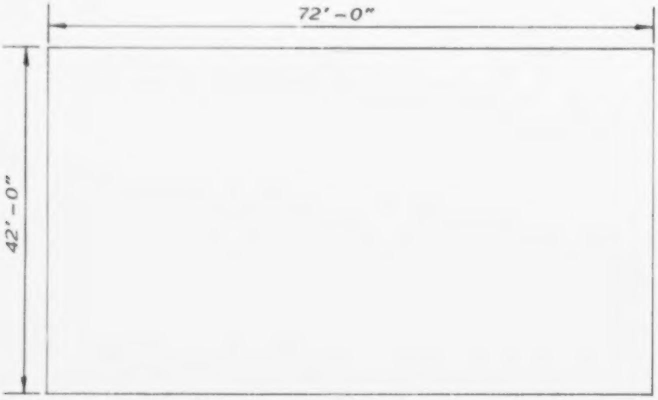
2. Number of rolls of R-19 batt insulation required for walls with 120 square feet per roll = ____________ rolls

3. Ceiling area to be insulated = ____________ square feet

4. Number of packages of loose-fill insulation for R-38 in the ceiling if each package will cover 64 square feet = ____________ packages

ASSIGNMENT SHEET #1

B. Estimate insulation materials needed for the structure illustrated below. The building will be constructed with a crawl space, 8'-0" ceiling height, and 178 square feet of wall openings.



1. Packages of R-19 insulation required for walls at 49 square feet per package = _____________packages

2. Packages of R-38 insulation required for ceiling at 64 feet per package = _____________packages

3. Packages of R-19 insulation required for floor at 49 square feet per package = _____________packages

INSULATION
UNIT I

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

(NOTE: Evaluate the student's work as well as the answers since answers may vary due to rounding.)

A. 1. 1,500
2. 13
3. 1,706
4. 27

B. 1. 34
2. 47
3. 62

INSULATION
UNIT I

JOB SHEET #1 — INSTALL VAPOR BARRIER AND INSULATION FOR A CONCRETE SLAB

I. Tools and materials

   A. 1" × 2' × 8' rigid insulation

   B. Polyethylene plastic film

   C. Mastic or special adhesive

   D. Utility knife or shears

   E. Putty knife or pointing trowel

   F. Folding rule or steel tape

II. Procedure

   A. Clean out along inside of foundation to a depth of 2'-4" below finish-floor elevation

   B. Install rigid insulation on edge (vertically) along the inside of the two long sides of the foundation

   C. Install rigid insulation on edge along the inside of the other two ends of the foundation

   D. Be sure that sand fill is graded to proper elevation for floor slab, then remove enough sand around the foundation's perimeter to allow for the 1-inch insulation

   E. Install horizontal pieces of insulation around the inside perimeter of the foundation, lapping the pieces over the top of the vertical pieces and placing them tightly against the foundation

   F. Lay a roll of plastic film at one end of the floor base and roll out film to the other end; measure this distance

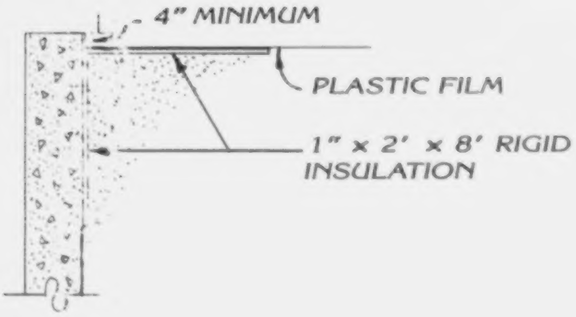
   G. Add 8 inches to distance determined in step F and cut plastic

   (NOTE: Plastic film should be carried up at least 4 inches at each foundation wall.)

   H. Unfold length of plastic and lay out flat on the sand fill, allowing 4 inches to carry the film up the foundation wall at both ends and 4 inches to carry the film up the side foundation wall (See Figure 13)

JOB SHEET #1

FIGURE 13


4" MINIMUM
PLASTIC FILM
1" × 2' × 8' RIGID INSULATION

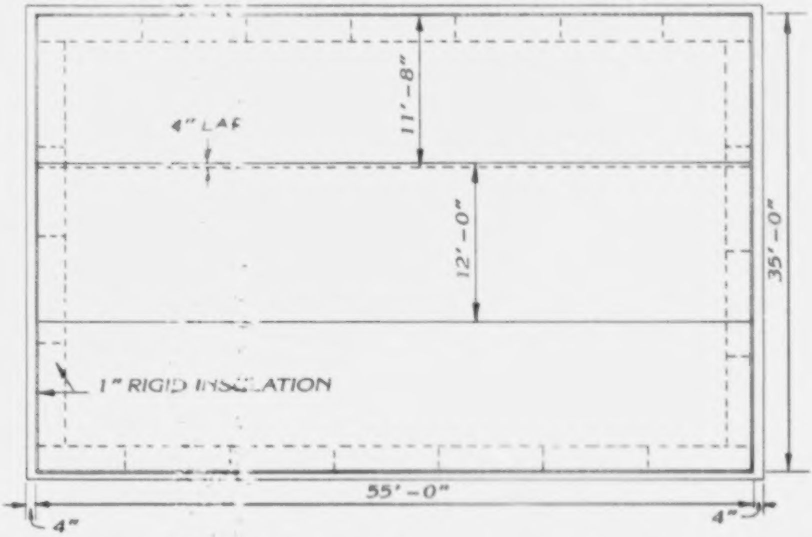
I. Roll out another piece of plastic to length determined in steps F and G and cut

J. Unfold this length and lay out on sand fill, allowing 4 inches to carry the film up the foundation wall at each end and 4 inches to lap this piece over the first piece

K. Continue following the procedures in steps I and J until entire area is covered (Figure 14)

(NOTE: If you end up with only a narrow strip to cover, you may want to piece it in with short pieces rather than waste a lot of material.)

FIGURE 14


4" LAP
11'-8"
12'-0"
35'-0"
1" RIGID INSULATION
55'-0"
4"
4"

L. Use mastic or adhesive to seal the seams where the plastic strips overlap and to hold the ends and edges up on the foundation walls

M. Clean up area and put away tools and materials

INSULATION
UNIT I

JOB SHEET #2 — INSTALL BLANKET INSULATION IN WALLS

I. Tools and materials

   A. Utility knife or shears

   B. Hand or pneumatic stapler

   C. Staples

   D. Tape

   E. Insulation batts

   F. Pencil

II. Procedure

   A. Measure space to be filled with insulation, and add 2 or 3 inches to that measurement

   (NOTE: Insulation should be 2 to 3 inches longer than the space to be filled; this allows enough length so that some of the batting can be removed from both ends to allow nail flanges on top and bottom.)

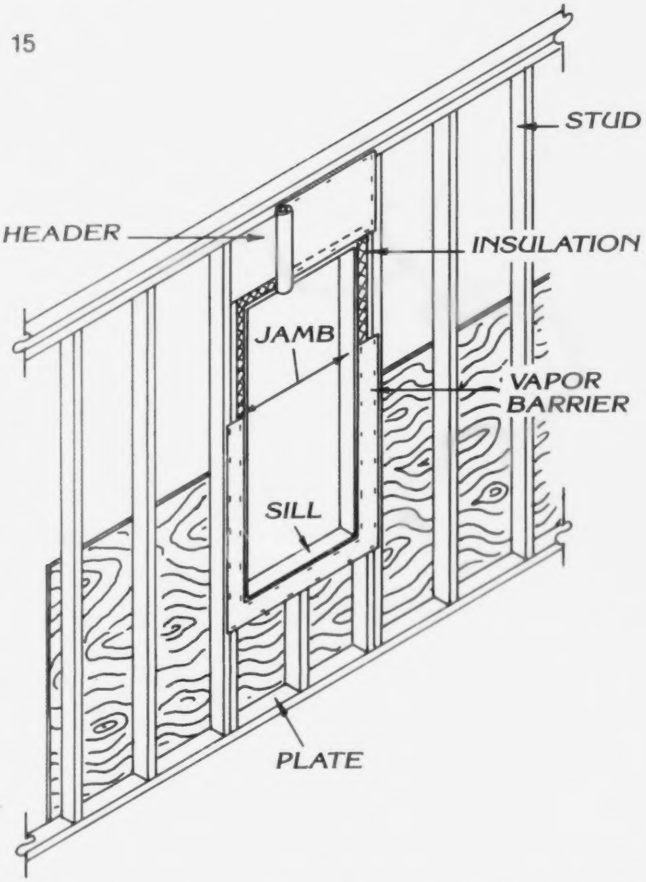
   B. Mark on the floor the length determined in step A

   C. Roll out insulation between marks on floor and cut insulation to length

   (NOTE: Save cut-off ends and pieces so that they may be used to fill small spaces around windows, doors, electrical boxes, and any other small opening. See Figure 15.)

JOB SHEET #2

FIGURE 15



D. Make nail flanges by removing about 1 inch of batting from the insulation's covering on each end of the cut length

E. Place insulation in wall opening with nail flange over top plate and side tabs over studs; carefully fit insulation around pipes, conduits, electrical boxes, and window and door frames (See Figure 15)

F. Staple the top nail flange to top plate and then, working from top to bottom and alternating from one side to the other, staple the side tabs to the studs, placing staples no more than 12 inches apart

G. Staple bottom nail flange to soleplate

H. Follow procedures in steps A through G until all walls are insulated

I. Check to see that no openings were missed and that all the insulation is properly installed; fill these openings as necessary

J. Clean up area and put away tools and materials

INSULATION
UNIT I

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with insulation to their correct definitions. Write the correct numbers in the blanks.

_____a. Process by which vapor becomes liquid

_____b. Material used in walls, ceilings, and floors to retard the passage of heat and sound

_____c. Process by which moisture moves into a structure

_____d. Insulating material installed at foundation and floor slab around perimeter of structure

_____e. Metal-surfaced insulating material exposed to an air space to reduce heat radiation across the air space

_____f. Material that prevents the passage of moisture or vapor into or through structural elements

1. Insulation
2. Perimeter insulation
3. Condensation
4. Vapor barrier
5. Moisture penetration
6. Reflective insulation

2. Explain the functions of the two basic kinds of insulation.

a. Thermal insulation — ______________________________

____

____

____

____

b. Acoustical insulation — ______________________________

____

____

____

____

TEST

3. Select from the following list benefits of using insulation in a structure. Write an "X" in the blank before each correct answer.

_____a. Reduces noise from the outside

_____b. Retards or resists the spread of fire

_____c. Reduces fuel expenses

_____d. Increases rapid temperature changes in a structure

_____e. Helps absorb echoes

_____f. Prevents condensation

4. List four types of insulation commonly used in residential construction.

a. _______________

b. _______________

c. _______________

d. _______________

5. Name three general classifications of insulation materials.

a. _______________

b. _______________

c. _______________

6. List four areas where insulation should be used in residential construction.

a. _______________

b. _______________

c. _______________

d. _______________

7. List factors that determine the amount of insulation needed for walls, ceilings, and floors.

a. _______________

b. _______________

c. _______________

TEST

8. Name three types of materials used for vapor barriers.

   a. ____________________

   b. ____________________

   c. ____________________

9. Select from the following list methods used to apply insulation and vapor barriers. Write an "X" in the blank before each correct answer.

   ______a. Stapled

   ______b. Nailed

   ______c. Fastened with powder-actuated tool

   ______d. Rolled out and taped at joints

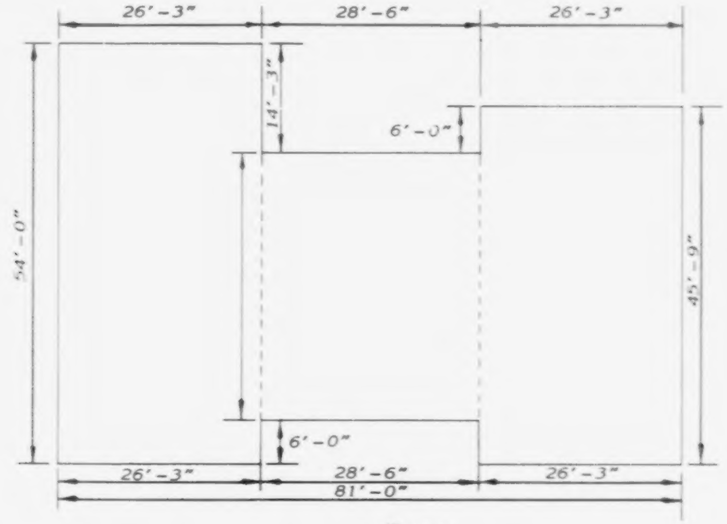
   ______e. Blown in

   ______f. Pressed in place and held with mastic

   ______g. Hand-poured

   ______h. Sprayed on

10. Estimate the packages of insulation needed for the structure illustrated below. The structure has 8-foot ceilings and 278 square feet of wall openings. Show your work. Write the correct answers in the blanks on the following page.



TEST

a. Total packages of R-11 insulation needed for walls at 96 square feet per package =

______________________ packages

b. Total packages of R-38 insulation needed for ceilings at 64 square feet per

package = ______________________ packages

(NOTE: Test question 11 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

11. Demonstrate the ability to

    a. Install vapor barrier and insulation for a concrete slab

    b. Install blanket insulation in walls.

INSULATION
UNIT I

ANSWERS TO TEST

1. a. 3 c. 5 e. 6
   b. 1 d. 2 f. 4

2. Explanation should include the following

   a. Retards the transfer of heat from inside a structure to the outside and from the outside into the structure
   b. Retards the passage of sound waves from the outside into a structure or from one room to another within the structure

3. a, b, c, e, f

4. Answer should include any four of the following

   a. Flexible batt insulation
   b. Flexible blanket insulation
   c. Loose-fill insulation
   d. Rigid board insulation
   e. Reflective insulation
   f. Adhesive-type insulation
   g. Corrugated-paper insulation
   h. Friction-batt insulation
   i. Foamed-plastic insulation

5. Answer should include any three of the following

   a. Mineral
   b. Vegetable (natural)
   c. Plastic
   d. Metal

6. Answer should include any four of the following

   a. Over ground in crawl space
   b. Around perimeter of concrete floors and foundations
   c. Between floor joists
   d. Between wall studs
   e. Above ceilings
   f. In roof structure

7. a. Average low and high temperatures
   b. Level of comfort desired
   c. Cost

ANSWERS TO TEST

8. Answer should include any three of the following

   a. Asphalt-coated paper
   b. Aluminum foil
   c. Polyethylene film
   d. Roll roofing

9. a, b, d, e, f, g, h

10. a. 22
    b. 56

11. Performance skills evaluated to the satisfaction of the instructor.

DRYWALL
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to discuss gypsum wallboard and estimate and install wallboard materials. The student will show this knowledge by completing the assignment sheets, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with drywall to their correct definitions.
2. Name types of gypsum wallboard.
3. Select from a list standard sizes of gypsum wallboard.
4. Identify standard edge shapes of gypsum wallboard.
5. State benefits of using gypsum wallboard.
6. Describe types of base or construction where wallboard is used.
7. Identify hardware and fasteners used with gypsum wallboard.
8. Select from a list types of finishes that may be applied to gypsum wallboard.
9. Estimate materials needed to dry wall a structure.
10. Demonstrate the ability to
    a. Install gypsum wallboard.
    b. Finish wallboard joints and depressions.
    c. Apply laminated gypsum wallboard.

DRYWALL
UNIT II

SUGGESTED ACTIVITIES

I. Unit contents

  A. Objective sheet

  B. Suggested activities

  C. Transparency masters

    1. TM #1 — Planning the Job
    2. TM #2 — Estimating Materials
    3. TM #3 — Tools Required
    4. TM #4 — Cutting Gypsum Wallboard
    5. TM #5 — Ceiling Installation
    6. TM #6 — Wall Application
    7. TM #7 — Metal Corner Bead
    8. TM #8 — Joint Finishing
    9. TM #9 — Applying Bedding Compound
    10. TM #10 — Applying Wallboard Tape
    11. TM #11 — Applying Finishing Coats
    12. TM #12 — Finishing Nailheads
    13. TM #13 — Finishing End Joints
    14. TM #14 — Finishing Metal Corner Bead

  D. Information sheet

  E. Assignment sheets

    1. Assignment Sheet #1 — Estimate Drywall Materials for a Room
    2. Assignment Sheet #2 — Estimate Drywall Materials for a House

  F. Answers to assignment sheets

SUGGESTED ACTIVITIES

G. Job sheets

  1. Job Sheet #1 — Install Gypsum Wallboard
  2. Job Sheet #2 — Finish Wallboard Joints and Depressions
  3. Job Sheet #3 — Apply Laminated Gypsum Wallboard

H. Test

I. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Obtain materials to supplement unit.

  1. Cut-away wall section showing drywall installation
  2. Samples of the various types of wallboard
  3. Literature from gypsum wallboard manufacturers
  4. Models of the various types of base construction where wallboard is used
  5. House plans illustrating wallboard installation
  6. Samples of hardware and fasteners used with gypsum wallboard
  7. Plans and schedules that show wallboard finish specifications
  8. Transparencies and competency profiles

  (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

C. Introduce unit.

SUGGESTIONS:

- Demonstrate or have a craftsman demonstrate the installation of plaster walls and ceilings and point out the time and labor plastering requires.
- Provide the class with representative costs for installing 100 square feet of plaster as compared to 100 square feet of drywall; also compare time requirements for the two jobs.

SUGGESTED ACTIVITIES

- Have a former student who works primarily as a drywall installer talk to the class about his or her job and training.

D. Provide students with objective sheet; discuss unit and specific objectives.

E. Provide students with information, assignment, and job sheets.

F. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Section I to discuss terms and definitions associated with drywall.

   SUGGESTIONS:

   - Show the class samples of materials when possible.
   - Show the class a cut-away wall section display with the drywall at various stages of installation to illustrate terms.

2. Use Information Sheet, Section II to discuss types of gypsum wallboard.

   SUGGESTIONS:

   - Invite a representative from a gypsum wallboard manufacturer or distributor to discuss the various types of gypsum wallboard.
   - Provide students with samples of each type of wallboard discussed in this section of the information sheet.
   - Take the class to visit a gypsum wallboard manufacturing plant.

3. Use Information Sheet, Section III to discuss standard sizes of gypsum wallboard.

   SUGGESTIONS:

   - Discuss reasons for and applications of the various sizes of wallboard.
   - Have students survey local distributors to determine what sizes of wallboard are normally available and which sizes must be special ordered.
   - Take the class to visit construction sites where a variety of wallboard sizes and types of gypsum wallboard are being used.

4. Use Information Sheet, Section IV to discuss edge shapes of gypsum wallboard.

   SUGGESTIONS:

   - Have a professional drywall installer discuss reasons for the various shapes and installation techniques required.

SUGGESTED ACTIVITIES

- Have students survey manufacturers and distributors to determine which edge shapes are available for the various types and sizes of wallboard.

5. Use Information Sheet, Section V to discuss benefits of using gypsum wallboard.

   SUGGESTIONS:

   - Demonstrate benefits, ease of repair, noncombustibility, etc.
   - Provide students with manufacturer's or association literature describing the benefits of gypsum wallboard.
   - Have a professional wallboard installer discuss the limitations and restrictions of using gypsum wallboard.

6. Use Information Sheet, Section VI to discuss types of base construction where wallboard is used.

   SUGGESTIONS:

   - Display models of the various construction methods discussed in this section of the information sheet.
   - Take the class to visit construction sites to view various types of wallboard installations.
   - Show the class plans for the various types of installations, and discuss the purpose of each type.

7. Use Information Sheet, Section VII to discuss hardware and fasteners used with gypsum wallboard.

   SUGGESTIONS:

   - Display samples of each type of hardware and fastener illustrated in this section of the information sheet.
   - Demonstrate the use of each type of hardware or fastener or invite drywall installers to demonstrate the use of each type, emphasizing hardware and fasteners commonly used in your area.

8. Use Information Sheet, Section VIII to discuss types of finishes for gypsum wallboard.

   SUGGESTIONS:

   - Have the class study house plans and schedules to review how finishes are specified.

SUGGESTED ACTIVITIES

- Take the class to visit construction sites to see the application of various finishes over gypsum wallboard; try to see various stages of the application procedure from bare walls marked for the type of application to finished walls.

9. Use Information Sheet, Section IX to discuss estimating materials needed to drywall a structure.

   SUGGESTIONS:

   - Discuss Assignment Sheets #1 and #2.
   - Have students complete Assignment Sheets #1 and #2.
   - Provide students with house plans and have them estimate materials, write up orders, and determine costs.

G. Use transparencies #1 through #14 to discuss the procedures in installing and finishing drywall. Emphasize careful handling of wallboard, safety requirements due to size and weight of wallboard materials, and power-tool safety.

H. Have students complete Job Sheets #1 and #2.

I. Discuss the procedures in Job Sheet #3.

J. Have students complete Job Sheet #3.

K. Give test.

L. Critique test and discuss in class.

M. Reteach if necessary.

N. Complete appropriate sections of competency profiles.

III. Unit references

A. *Goldblatt Tool Company Catalog*. Kansas City, Kansas: Goldblatt Tool Company, 1983.

B. Hendrix, Laborn J. "Bud." *Commercial Carpentry*. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1979.

C. Wagner, Willis H. *Modern Carpentry*. South Holland, Illinois: The Goodheart-Willcox Company, Inc., 1976.

1 Planning the Job

A little thought and planning before you start your project can result in a better-appearing job and a savings in materials and time. Make a sketch of the areas to be surfaced with gypsum wallboard and lay out the board panels. Install the boards across (perpendicular to) the joists or studs. Use as long a board as can be handled to eliminate or reduce end joints. For example, in a 12′ × 13′ room where the ceiling joists run parallel to the 13-foot dimension, it is desirable to have the boards be 12 feet long. If they are 8 feet long, an end joint would be necessary in each course. Where end joints cannot be avoided, they should be staggered.

It is usually better to apply the board on the ceiling first, then the sidewalls.

It is often easier to use the adhesive nail-on method of application. This method results in fewer nails to drive and conceal and makes a higher-quality installation.

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2 Estimating Materials

Using your sketch, determine the lengths and number of boards required. Nails can be estimated from the chart below. About 50 percent fewer nails are required if the adhesive nail-on method is used.

Estimating Nails

Wallboard Thickness	Nail Type	Approx. lbs per 1,000 sq ft of Gypsum Wallboard
$\frac{3}{8}$", $\frac{1}{2}$"	$1\frac{5}{8}$" coated-type drywall nail	$5\frac{1}{4}$ lb
$\frac{5}{8}$"	$1\frac{7}{8}$" coated-type drywall nail	$5\frac{1}{4}$ lb

After the wallboard is installed, the flat joints and inside corners are to be reinforced with a paper tape and joint compound. The outside corners are to be reinforced with a drywall metal corner bead and joint compound. G-P Ready-Mix is a premixed, ready-to-use product that can be used for the complete job of taping, filling, spotting, nailheads, and finishing.

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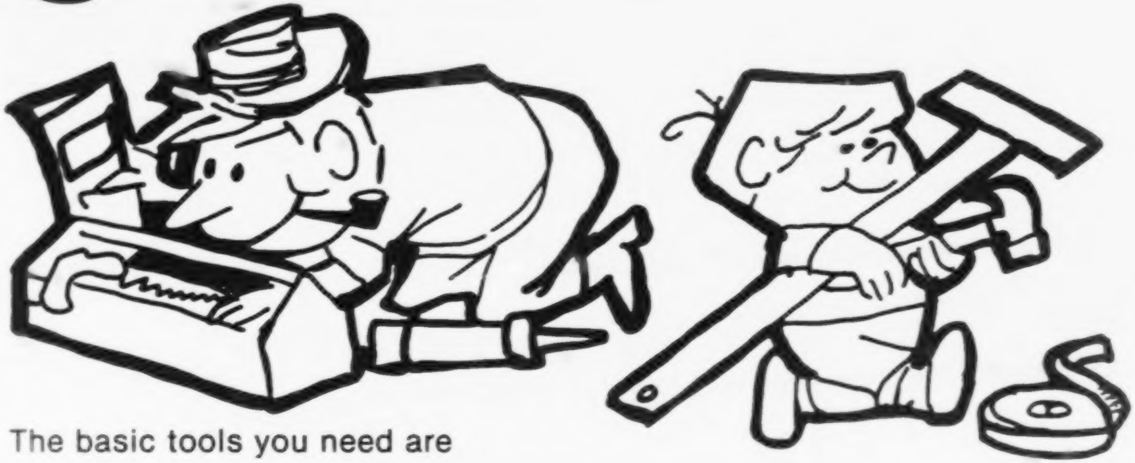
3 Tools Required



The basic tools you need are

1. Wallboard cutting knife and heavy-duty knife blade
2. Wallboard hammer or regular crown-head carpenter's claw hammer
3. 4-foot T-square or steel straightedge
4. Steel tape measure
5. Utility saw or keyhole saw
6. Joint-finishing knives with 4-inch and 10-inch blades
7. Plastic pan for joint compound
8. Sandpaper (medium texture) for joint finishing
9. Caulking gun

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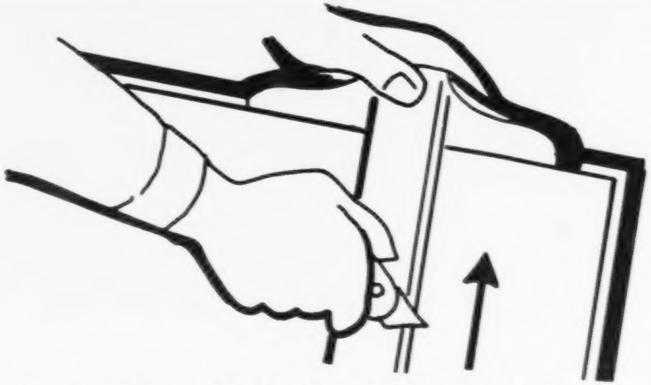
4

Cutting Gypsum Wallboard



Use T-square and wallboard knife for scoring. With the knife at right angles to the board, score completely through the face paper. Then apply firm, even pressure to snap the board. Fold back the partially separated portion of the board and use the knife again to cut the back paper. Rough edges should be smoothed. Panels can be cut with a saw if desired.

Cutting Openings

It will be necessary to cut holes in the wallboard for electrical outlets, light receptacles, etc. The distance of the opening from the end and edge of the board should be carefully measured and marked on the face of the wallboard. The opening should then be outlined in pencil and cut out with a keyhole saw. The cutout must be accurate or the cover plate will not conceal the hole.

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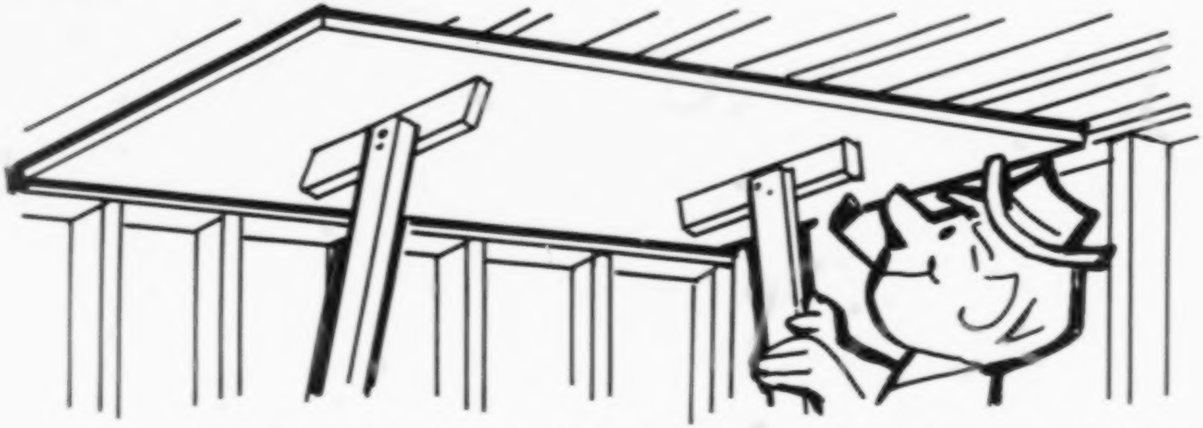
5 Ceiling Installation



It is more difficult to install the ceiling boards because of the overhead positioning. It is desirable to have T-braces to hold the board in place while it is being nailed. A satisfactory T-brace consists of a 2-foot piece of 1×4 nailed onto the end of a 2×4. The length should be about 1 inch longer than the floor-to-ceiling height. The nails should be 7 inches apart. When the adhesive nail-on method is used, the edges should be nailed, but place only one nail per joist in the field of the board. All edges should be supported on framing. The nails should be driven to bring the board tight to the framing, then another blow struck to dimple the nail, being careful not to break the face paper.

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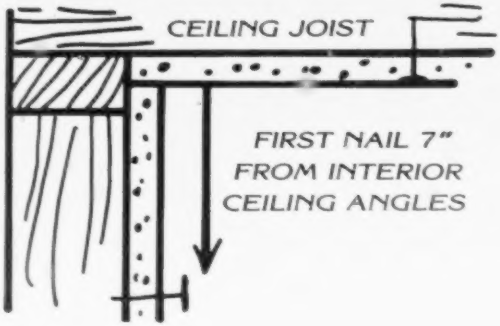
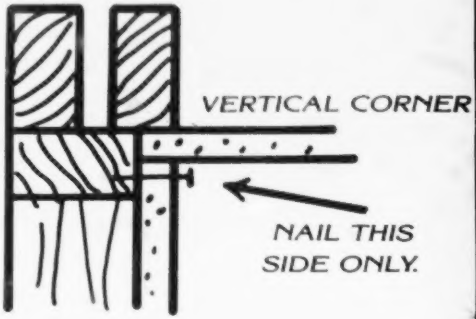
6 Wall Application





In horizontal application on sidewalls, install the top board first. Push the board up firmly against the ceiling and nail, placing nails 7 inches apart. One exception, however, is to keep all nails back 7 inches from interior ceiling angles. Nails in the interior angles are quite apt to pop. If the adhesive nail-on method is used, all of the field nailing can be eliminated. The nailing is around the edges of the board. If the board is bowed out in the center, it may be advisable to secure it with a temporary nail until the adhesive sets.

A vertical application places the long edges of the wallboard parallel to the framing members. This is more desirable if the ceiling height of your wall is greater than 8′-2″ or the wall is 4 feet wide or less. Nailing recommendations are the same as for horizontal application.

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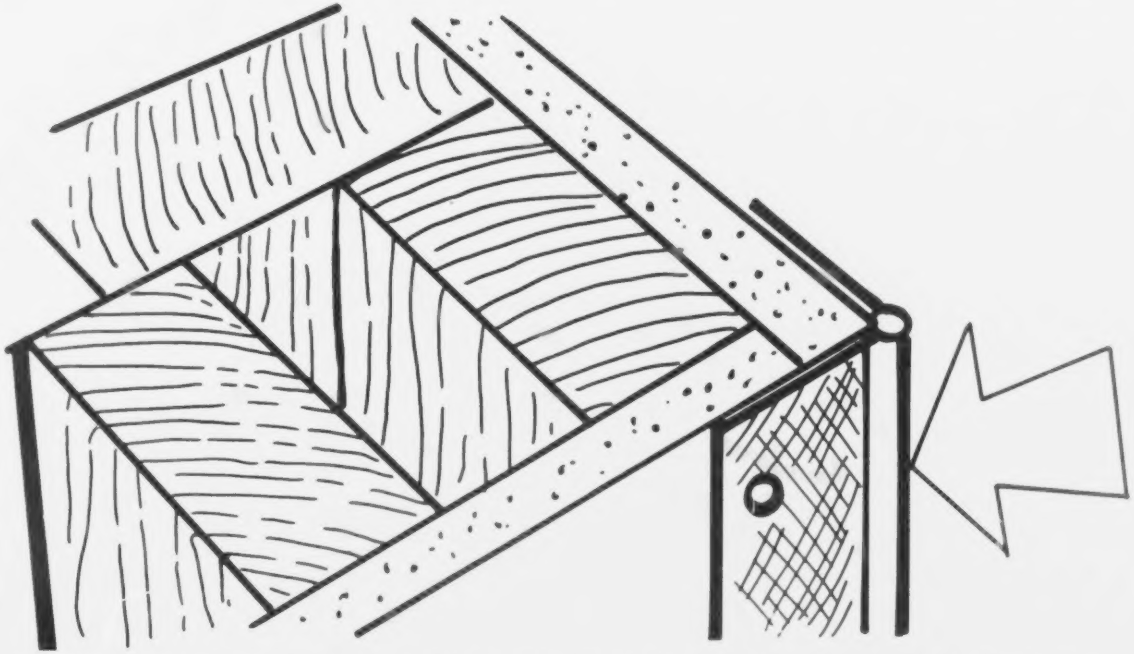
7 Metal Corner Bead



To protect corners from edge damage, install metal corner bead after you have installed the wallboard. Nail the metal corner bead every 5 inches through gypsumboard into wood framing.

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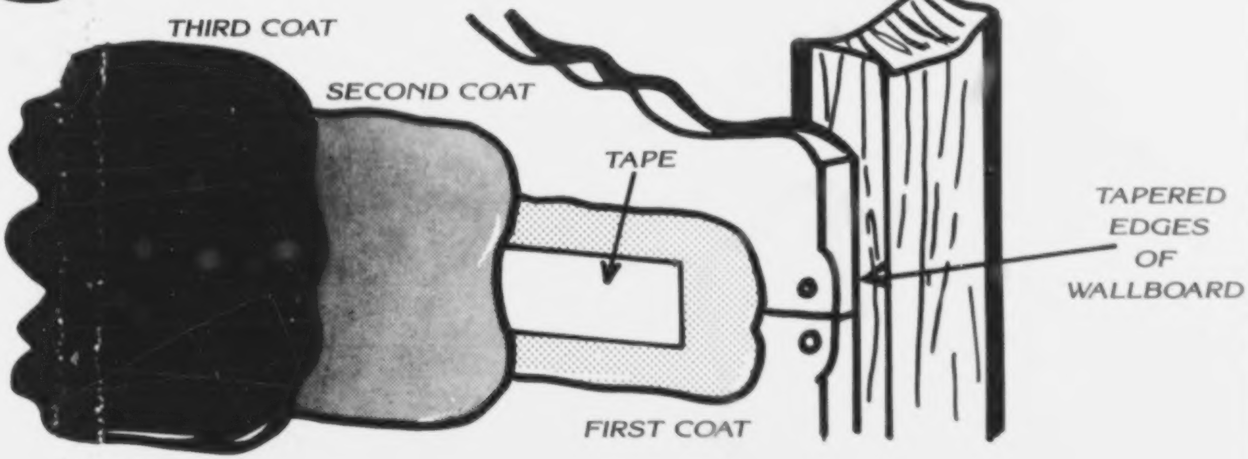
TM #7

RC - 67-F

8 Joint Finishing



A premixed material such as G-P Ready-Mix joint compound is the easiest to use to finish joints, corners, and nailheads. A minimum of three coats of Ready-Mix is recommended for all taped joints. This includes an embedding coat to bond the tape and two finishing coats over the tape. Each coat should dry thoroughly, usually twenty-four hours, so that the surface can be easily sanded. When sanding, wrap your sandpaper around a wood sanding block so you sand the surface evenly. Do not over-sand or sand the paper surface. This may outline the joint or nailhead through the paint.

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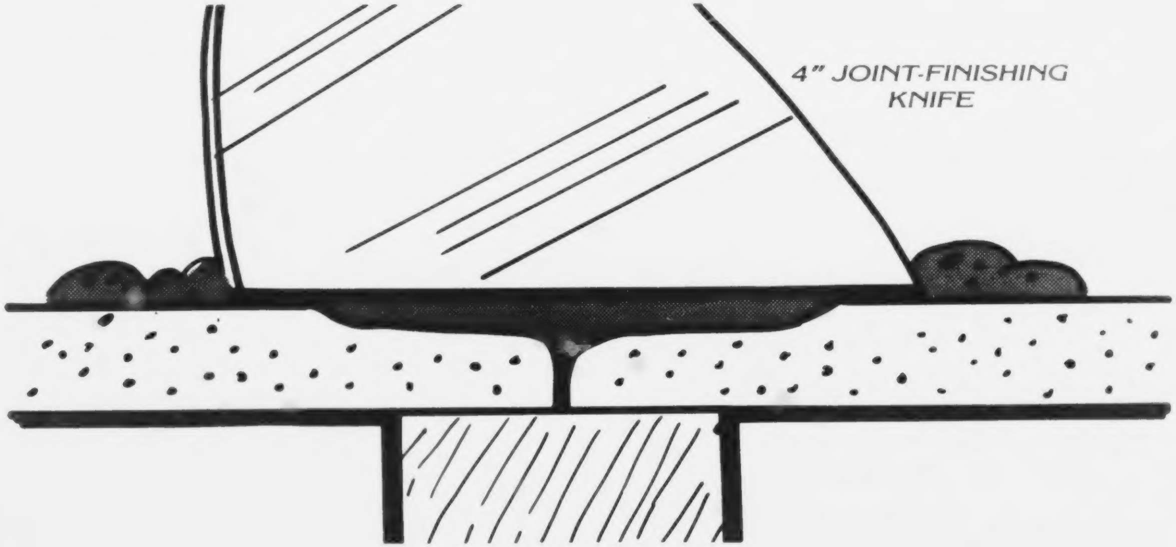
9 Applying Bedding Compound



Take your 4-inch joint-finishing knife and apply the Ready-Mix joint compound fully and evenly into the slight recess created by the adjoining edges of the board.

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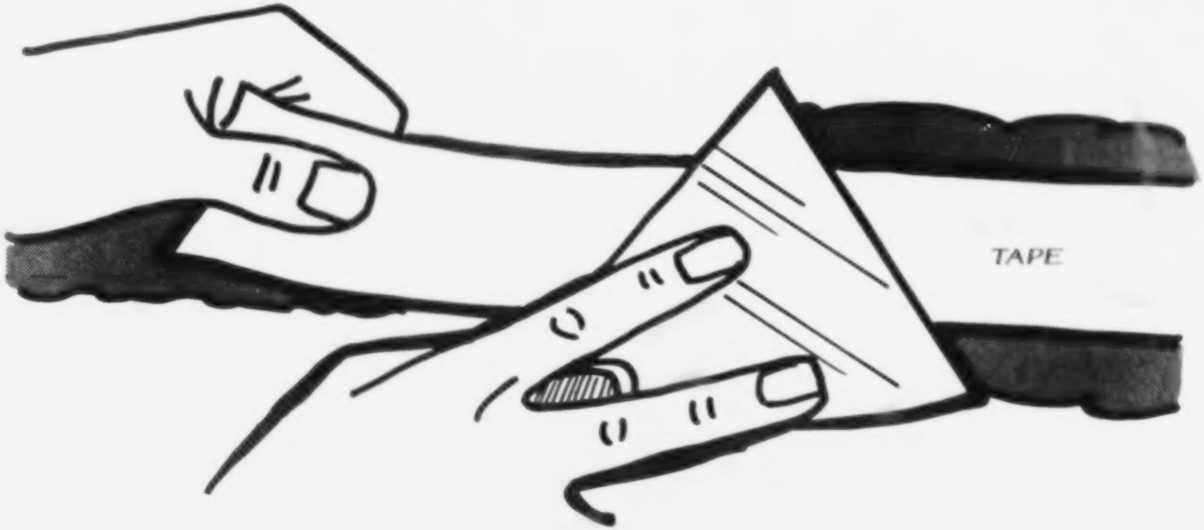
921

922

10 Applying Wallboard Tape



Next, take your wallboard tape and center it over the joint. Press the tape firmly into the bedding compound with your wallboard knife held at a 45-degree angle. The pressure should squeeze some compound from under the tape, but enough must be left for a good bond.

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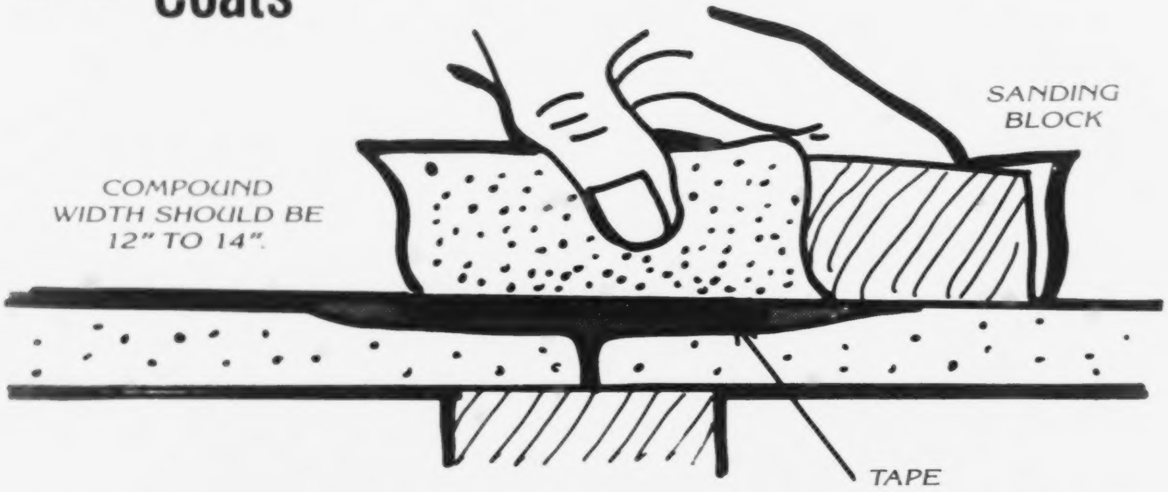
TM #10

RC - 73-F

11 Applying Finishing Coats



When thoroughly dry, at least twenty-four hours, apply a fill coat extending a few inches beyond the edge of the tape, and feather the edges of the compound. When the first finishing coat is thoroughly dry, use your 10-inch joint-finishing knife to apply a second coat, and feather the edges about 1½ inches beyond the first coat. When this coat is dry, sand lightly to a smooth, even surface. Wipe off the dust in preparation for the final decoration. Total width should be 12 to 14 inches.

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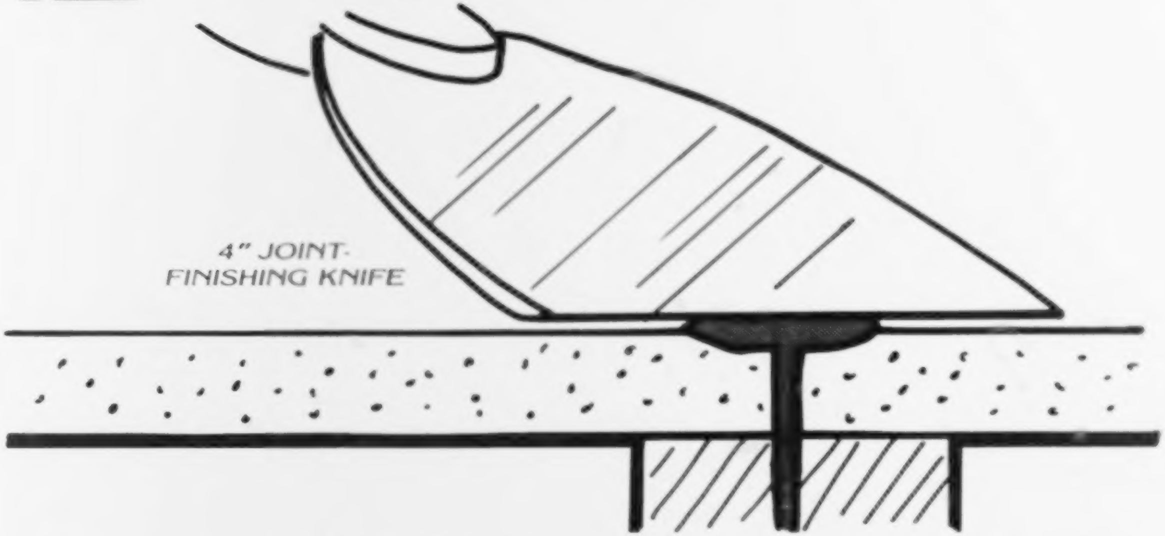
12

Finishing Nailheads



Draw your 4-inch joint-finishing knife across nails to be sure they are below the surface of the board. Apply first coat of Ready-Mix with even pressure to smooth compound level with the surface of the board. Do not bow knife blade with excess pressure as this tends to scoop compound from dimpled area. When dry, apply second coat; let dry; sand lightly, and apply third coat. Sand lightly before applying your decoration. An additional coat may be needed, depending on temperature and humidity.

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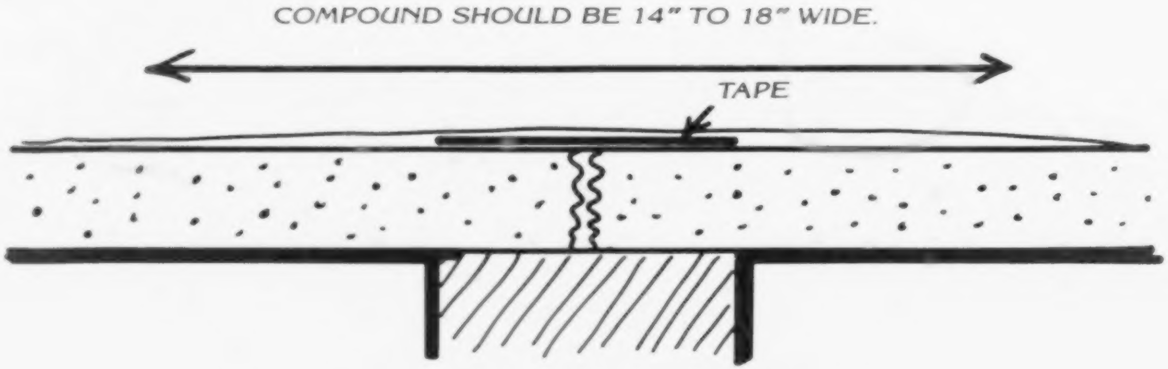
13 Finishing End Joints



You use basically the same steps with end or butt joints as you do with tapered edges. The end joints are not tapered, so care must be taken not to build up the compound in the center of the joint. This encourages ridging and shadowed areas. Feather the compound well out on each side of the joint. Final application of joint compound should be 14 to 18 inches wide.

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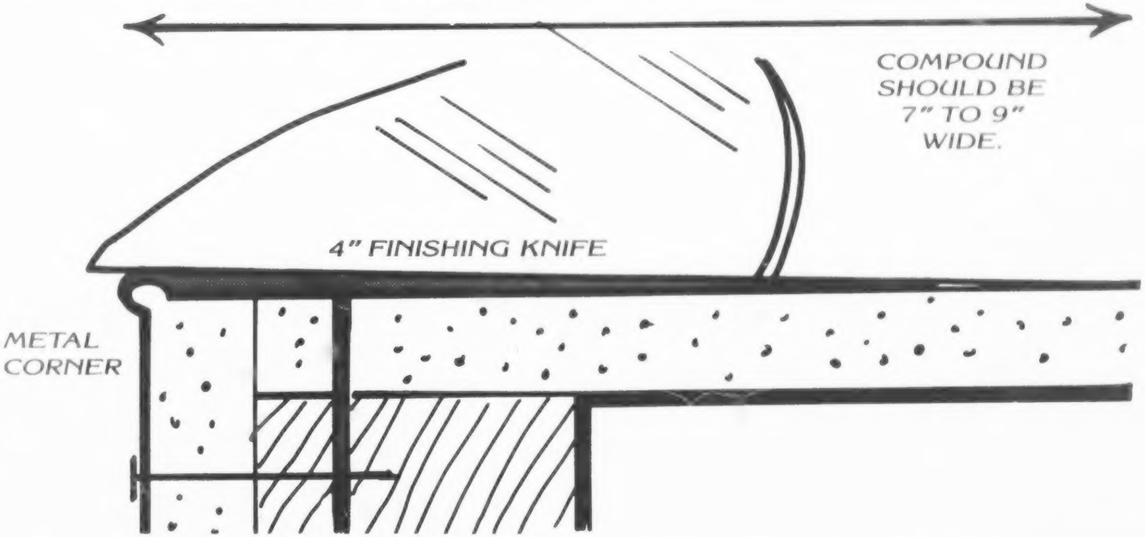
14

Finishing Metal Corner Bead


COMPOUND SHOULD BE 7" TO 9" WIDE.
4" FINISHING KNIFE
METAL CORNER

Be sure the metal corner is attached firmly. Take your 4-inch finishing knife and spread the G-P Ready-Mix 3 to 4 inches wide from the nose of the bead, covering the metal edges. When completely dry, sand lightly and apply second coat, feathering edges 2 to 3 inches beyond the first coat. A third coat may be needed, depending on your coverage. Feather the edges of each coat 2 or 3 inches beyond the preceding coat.

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DRYWALL
UNIT II

INFORMATION SHEET

I. Terms and definitions associated with drywall

A. Drywall — Any rigid sheathing material applied to interior finish walls and ceilings

B. Wallboard — Rigid sheathing material made with a noncombustible core (usually gypsum) that is surfaced with treated paper or some other sheet material; sheathing material applied to interior finish walls and ceilings

C. Backing — Strips of wood nailed on top of top plate between joists and at inside wall angles of partitions; provides a solid base for nailing wallboard

D. Joint — Place where edges of two pieces of wallboard meet

E. Perforated tape — Paper tape used as reinforcement at wallboard joints to keep surface from cracking

(NOTE: Perforated tape comes in rolls that are 2 inches wide and 60, 250, or 500 feet long.)

F. Bedding — Joint compound applied to depression formed by butt joints and tapered wallboard edges

G. Joint compound — Compound used to embed perforated tape to wallboard joints, to finish over tape and corner bead, and to finish over nail or screw heads

H. Topping — Finish coat of compound that covers all previous coats

I. Quick-weld compound — Compound specially blended to set in from 20 to 90 minutes; is used almost exclusively in constructing manufactured housing

J. Featheredge — To spread joint compound or topping so that it tapers to a thin edge

K. Dimple — Impression on wallboard surface formed by a nail driven to proper depth

L. Double nailing — Pattern used when two nails are spaced 2 inches apart every 12 inches; pattern used on intermediate joists and studs

M. Laminate — To make by uniting two or more layers of material

II. Types of gypsum wallboard

A. Regular

(NOTE: Regular wallboard is the most commonly used gypsum wallboard.)

INFORMATION SHEET

B. Type "X"

(NOTE: Type "X" gypsum wallboard has a harder core than the regular type of wallboard.)

C. Insulating

(NOTE: Insulating gypsum wallboard, as the name implies, has insulation mixed into the core.)

D. Backing board

(NOTE: Backing-board gypsum wallboard does not have a finished surface; therefore, it is used where it will be covered with a finished material, such as paneling.)

E. Core board

(NOTE: Core-board gypsum wallboard is 1 inch thick and is made up of wood filler and gypsum. It is sometimes used as subflooring.)

F. Fire code

(NOTE: Fire-code gypsum wallboard has a surface coating that prevents the spread of fires.)

G. Waterproof

(NOTE: Waterproof gypsum wallboard is recognized by its green or blue color; it is used in bathrooms and other areas that are exposed to moisture.)

H. Predecorated

(NOTE: Predecorated wallboard is available in a variety of surface materials, designs, and patterns; it is usually installed vertically because of the difficulty in matching and finishing the butt joints.)

III. Standard sizes of gypsum wallboard

(NOTE: Wallboard can be special ordered to specific sizes. Being able to buy wallboard in different sizes reduces building costs substantially.)

A. Standard thicknesses

(NOTE: The $^1/_2$-inch and $^5/_8$-inch thicknesses are the most commonly used sizes.)

1. $^1/_4$ inch
2. $^3/_8$ inch
3. $^1/_2$ inch
4. $^5/_8$ inch
5. 1 inch

INFORMATION SHEET

B. Standard width — 4 feet

(NOTE: All gypsum wallboard comes in 4-foot widths.)

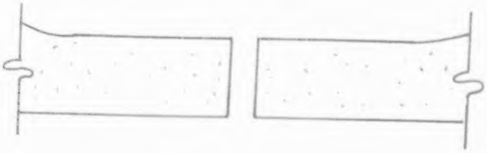
C. Standard lengths

1. 4 feet
2. 6 feet
3. 8 feet
4. 10 feet
5. 12 feet
6. 16 feet

IV. Standard edge shapes of gypsum wallboard (Figures 1-5)

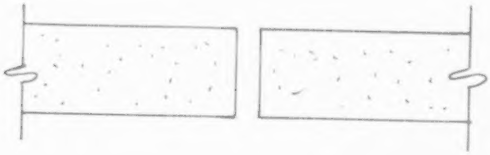
A. Tapered

FIGURE 1



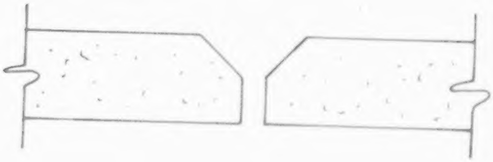
B. Square

FIGURE 2



C. Beveled

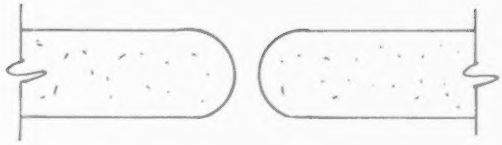
FIGURE 3



INFORMATION SHEET

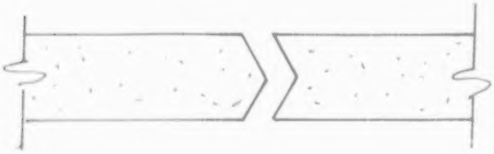
D. Round

FIGURE 4



E. Tongue and groove (T & G)

FIGURE 5



V. Benefits of using gypsum wallboard

- A. Is easily applied
- B. Is economical
- C. Is easily maintained
- D. Is easily repaired
- E. Is noncombustible
- F. Provides a good base for applying finish materials

VI. Types of base or construction where wallboard is used

- A. Single layer applied to wood framework
- B. Single layer applied to metal framework
- C. Single layer applied directly to masonry walls
- D. Single layer applied to wood or metal furring strips
- E. Single layer used as subflooring

  (NOTE: Core board is used as subflooring.)
- F. Double layer (two-ply) nailed, screwed, or laminated to base layer

INFORMATION SHEET

VII. Hardware and fasteners used with gypsum wallboard

A. Hardware

1. Metal corner bead (Figures 6 and 7)

FIGURE 6

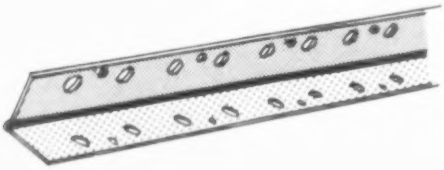
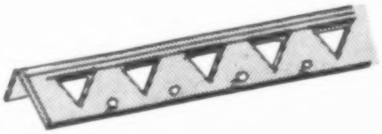


FIGURE 7



2. Metal casing bead (Figures 8-10)

FIGURE 8

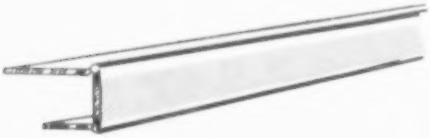


FIGURE 9

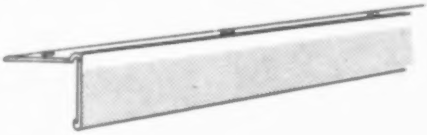
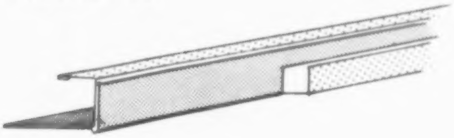


FIGURE 10



3. Flex-tape corner (Figures 11 and 12)

FIGURE 11: Flex-tape on roll

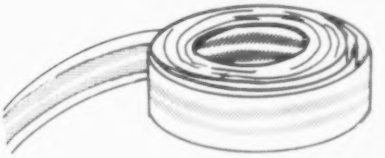
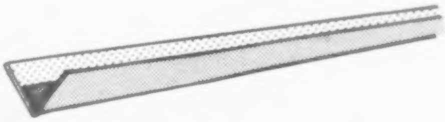


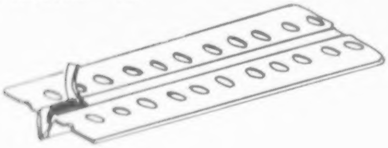
FIGURE 12: Flex-tape shaped into a corner



INFORMATION SHEET

4. Expansion joint (Figure 13)

FIGURE 13

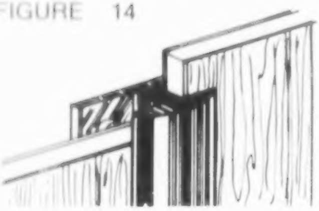


5. Molding for predecorated wallboard (Figures 14-17)

(NOTE: Molding generally matches the colors or patterns used in the predecorated wallboard, which is applied to the wall with adhesive or colored nails.)

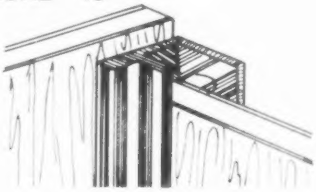
a. Divider

FIGURE 14



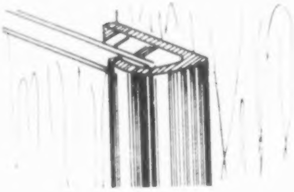
b. Inside corner

FIGURE 15



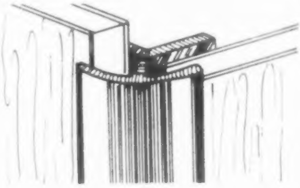
c. End cap

FIGURE 16



d. Outside corner

FIGURE 17

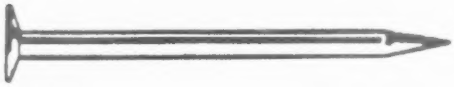


B. Fasteners

(NOTE: Drywall nails, screws, and staples may be purchased in a variety of sizes and lengths.)

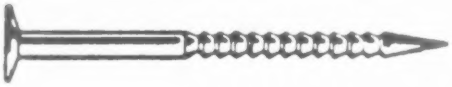
1. Coated nail (Figure 18)

FIGURE 18



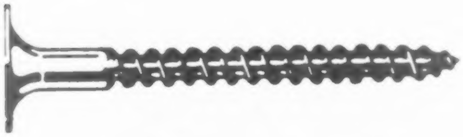
2. Annular-ring nail (Figure 19)

FIGURE 19



3. Phillips-head screw (Figure 20)

FIGURE 20



4. Staple (Figures 21 and 22)

FIGURE 21

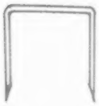
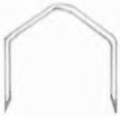


FIGURE 22



VIII. Types of finishes that may be applied to gypsum wallboard

A. Paint

B. Wallpaper

C. Texture

D. Paneling

E. Ceramic tile

F. Acoustical tile

G. Predecorated finishes

(NOTE: Predecorated finishes are applied by the manufacturer.)

IX. Estimating materials needed to dry wall a structure

(NOTE: Gypsum wallboard is estimated in square feet figured to the nearest 6 inches.)

A. Determine total square footage to be covered with wallboard

INFORMATION SHEET

1. Check plans and compute square footage of floor space in structure

2. Multiply square footage of floor space times 3.625 ($3^5/_8$) and round up to the nearest square foot to find total square footage of ceilings and walls to be covered with wallboard

   (NOTE: The number 3.625 [$3^5/_8$] is a constant that represents the square feet of flat ceiling and 8-foot walls for each square foot of floor.)

   EXAMPLE: If the square footage of floor space of a structure is 1,206 square feet, then

   1,206 sq ft × 3.625 = 4,371.75 sq ft = 4,372 total sq ft to be covered with wallboard

B. Determine number of sheets of each size of wallboard needed

(NOTE: Estimators like to order three-fourths of the total amount of wallboard needed in 12-foot sheets and one-fourth in 8-foot sheets. Also, wallboard is generally applied at right angles to ceiling joists and horizontally to walls. To reduce joint treatment and cracking, vertical joints are placed over door and window openings at least 6 inches from the end of the header.)

1. Check plans and compute square footage of special wallboard needed

2. Compute number of 4′ × 12′ sheets needed

   a. Multiply total square footage to be covered by wallboard times $^3/_4$ to find square footage to be covered by 4′ × 12′ sheets

      EXAMPLE: If there are 4,372 square feet to be covered by wallboard, then

      4,372 sq ft × $^3/_4$ = 3,279 sq ft = 3,279 sq ft to be covered by 4′ × 12′ sheets

   b. Divide square footage to be covered by 4′ × 12′ sheets by 48 to find number of 4′ × 12′ sheets needed

      (NOTE: Forty-eight is the number of square feet in each 4′ × 12′ sheet of wallboard.)

      EXAMPLE: If there are 3,279 square feet to be covered by 4′ × 12′ sheets, then

      3,279 sq ft ÷ 48 sq ft = 68.31 sheets = 68 sheets needed

INFORMATION SHEET

3. Compute number of 4′ × 8′ sheets needed

   a. Subtract square footage to be covered by 4′ × 12′ sheets from total square footage to be covered by wallboard to find square footage to be covered by 4′ × 8′ sheets

   EXAMPLE: If there are 4,372 square feet to be covered with wallboard and 3,279 square feet to be covered by 4′ × 12′ sheets, then

   4,372 sq ft − 3,279 sq ft = 1,093 sq ft to be covered by 4′ × 8′ sheets

   b. Divide total square footage to be covered by 4′ × 8′ sheets by 32 to find number of 4′ × 8′ sheets needed

   (NOTE: Thirty-two is the number of square feet in each 4′ × 8′ sheet of wallboard.)

   EXAMPLE: If there are 1,093 square feet to be covered by 4′ × 8′ sheets, then

   1,093 sq ft ÷ 32 sq ft = 34.15 sheets = 34 sheets needed

C. Determine amount of fastening and finishing materials needed

1. Use Table 1 to find the amount of nails, screws, joint compound, tape, and texture paint needed per 1,000 square feet of wallboard

   (NOTE: Nail spacing should be a minimum of 7 inches on ceilings and 8 inches on walls; however, when double nailing is used, nails are spaced 2 inches apart every 12 inches.)

TABLE 1: Fastening and Finishing Materials Required for 1,000 Square Feet of Wallboard

Material	Amount
1¼″ annular-ring nail	6¼ lb
1⅜″ annular-ring nail	6¾ lb
1″ drywall screw	3 lb
1¼″ drywall screw	4¼ lb
1⅝″ drywall screw	5½ lb
Ready-mix joint compound	80 lb (50-lb container)
Dry joint compound	50 lb (25-lb bag)
Perforated tape	370 lin ft
Texture paint	10 lb to 50 lb (25-lb bags)

INFORMATION SHEET

EXAMPLE: If a structure has 4,048 square feet to be covered with wallboard and fastened with 1¼-inch annular-ring nails, then

6¼ lb × 4 = 25 lb of annular-ring nails needed

2. Check manufacturer's recommendations to find the amount of adhesive needed for the type of adhesive you are using

   (NOTE: Each type of wallboard adhesive has a different coverage capability; therefore, always follow the manufacturer's recommendation.)

3. Check plans and count the number of outside metal corners needed

DRYWALL
UNIT II

ASSIGNMENT SHEET #1 — ESTIMATE DRYWALL MATERIALS FOR A ROOM

NAME ______________________________ SCORE ______________

The use of wallboard is a great convenience to the carpenter. It saves a great deal of time and money over constructing walls and ceilings from lath and plaster. However, these savings can be quickly lost if materials are poorly estimated. Estimates need to be accurate to avoid unnecessary handling of wallboard or delays due to ordering too little material. This assignment will help you become proficient in estimating drywall materials.

Using Information Sheet, Section IX, estimate the amounts of the following materials needed to dry wall the room illustrated on the following page. Show your work in the space provided at the bottom of this page. Write the correct answers in the blanks.

A. Square feet of gypsum wallboard needed to cover walls and ceiling = ______________

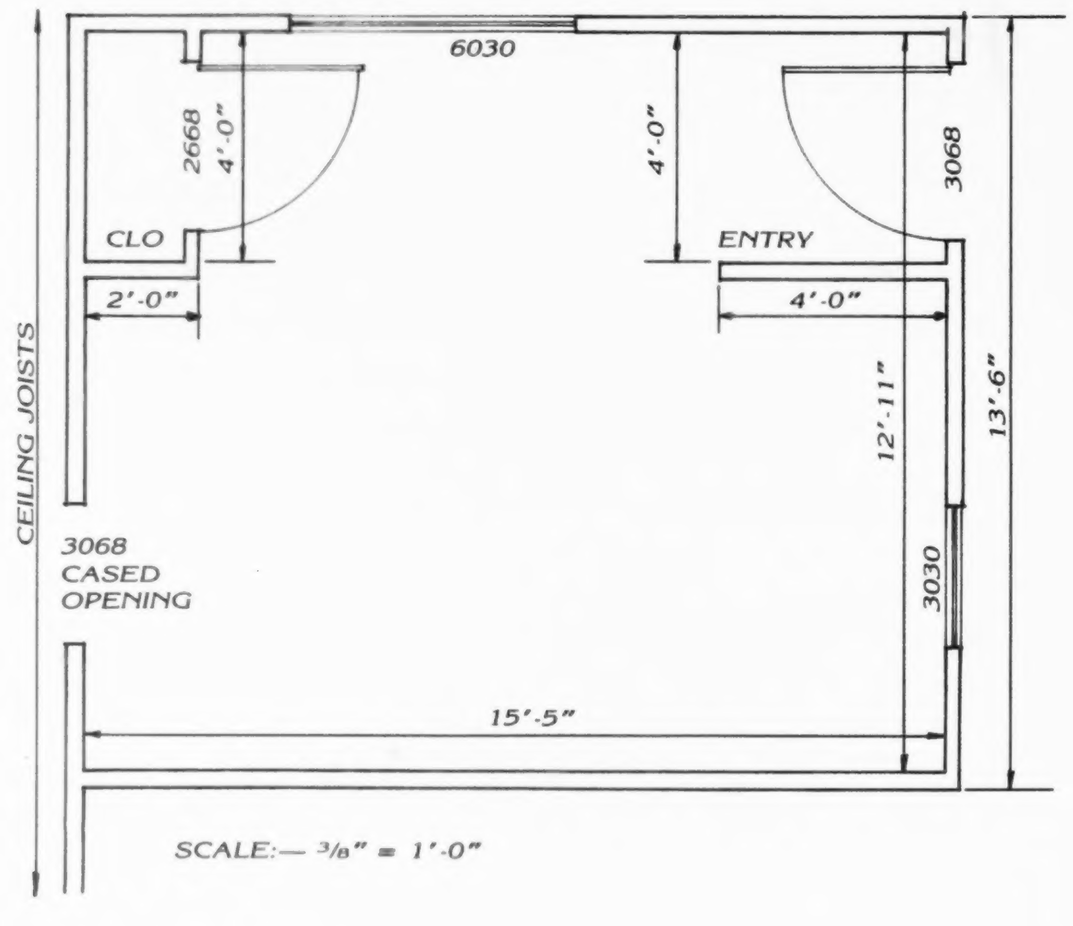
B. Pounds of 1¼-inch annular-ring nails needed = ______________

C. Feet of perforated tape needed = ______________

D. Pounds of ready-mix joint compound needed = ______________

E. Number of outside metal corners needed = ______________

ASSIGNMENT SHEET #1


6030
2668
4'-0"
4'-0"
3068
CLO
ENTRY
2'-0"
4'-0"
CEILING JOISTS
12'-11"
13'-6"
3068
CASED
OPENING
3030
15'-5"
SCALE:— 3/8" = 1'-0"

DRYWALL
UNIT II

ASSIGNMENT SHEET #2 — ESTIMATE DRYWALL MATERIALS FOR A HOUSE

NAME ______________________________ SCORE ______________

The key to accurate estimating of drywall materials is in determining the square footage of the area to be finished. Generally, the carpenter will base estimates on sections of a house to reduce the variation in numbers of interior walls and other factors. This assignment will help you to become able to figure accurate estimates.

PART I

Calculate the square feet of walls and ceilings for the rooms in the structure illustrated on the next page. Show your work in the space provided below and write the correct answers in the blanks.

A. Bedroom #1, closet, and short hallway = ______________________________

B. Living room = ______________________________

C. Kitchen, bath, and furnace room = ______________________________

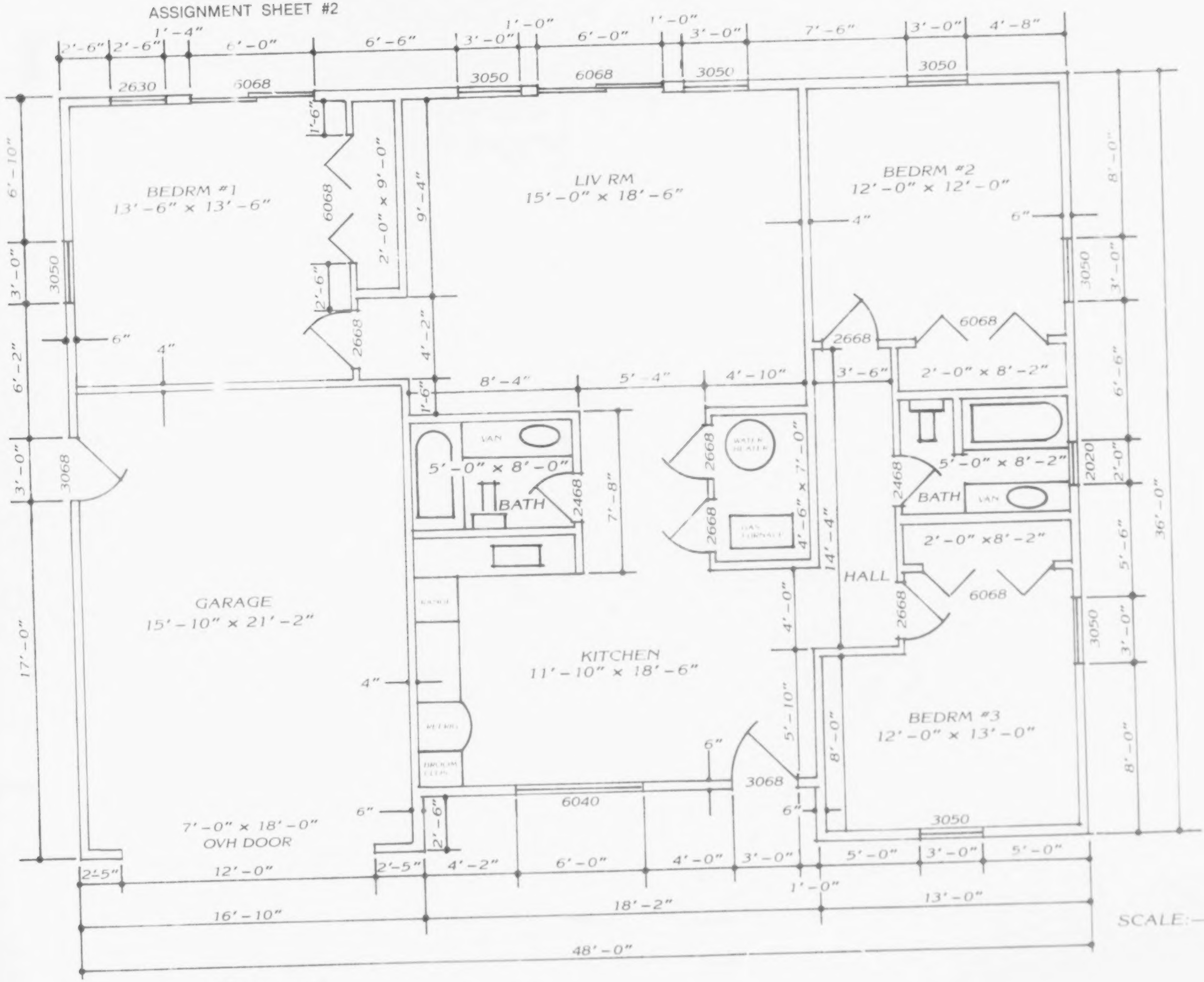
D. Bath and hallway = ______________________________

E. Bedroom #2 and closet = ______________________________

F. Bedroom #3 and closet = ______________________________

G. Garage = ______________________________

ASSIGNMENT SHEET #2


1'-4"
1'-0"
1'-0"
2'-6"
2'-6"
6'-0"
6'-6"
3'-0"
6'-0"
3'-0"
7'-6"
3'-0"
4'-8"
2630
6068
3050
6068
3050
3050
6'-10"
3'-0"
3050
6'-2"
3'-0"
3068
17'-0"
1'-6"
2'-6"
6068
2'-0" × 9'-0"
9'-4"
2668
4'-2"
1'-6"
BEDRM #1
13'-6" × 13'-6"
6"
4"
LIV RM
15'-0" × 18'-6"
BEDRM #2
12'-0" × 12'-0"
4"
6"
8'-0"
3050
3'-0"
6068
2668
3'-6"
2'-0" × 8'-2"
6'-6"
8'-4"
5'-4"
4'-10"
VAN
5'-0" × 8'-0"
BATH
2468
7'-8"
2668
2668
WATER HEATER
GAS FURNACE
4'-6" × 7'-0"
14'-4"
5'-0" × 8'-2"
2468
BATH
VAN
2020
2'-0"
36'-0"
2'-0" ×8'-2"
HALL
6068
2668
5'-6"
3050
3'-0"
GARAGE
15'-10" × 21'-2"
RANGE
4'-0"
KITCHEN
11'-10" × 18'-6"
4"
REFRIG
BROOM CLOS
6"
5'-10"
8'-0"
BEDRM #3
12'-0" × 13'-0"
8'-0"
3068
6"
6040
6"
2'-6"
7'-0" × 18'-0"
OVH DOOR
3050
2'-5"
12'-0"
2'-5"
4'-2"
6'-0"
4'-0"
3'-0"
5'-0"
3'-0"
5'-0"
1'-0"
16'-10"
18'-2"
13'-0"
48'-0"

SCALE:— 3/16" = 1'-0"

ASSIGNMENT SHEET #2

PART II

Using the Information Sheet, Section IX, estimate the amounts of the following materials needed to apply and finish wallboard for the structure illustrated on the preceding page. Show your work in the space below and write the correct answers in the blanks.

A. Total square feet = ______________________________

B. Total square feet of drywall needed = ______________________________

C. Pounds of 1¼-inch annular-ring nails = ______________________________

D. Feet of perforated joint tape needed = ______________________________

E. Pounds of ready-mix joint compound needed = ______________________________

F. Number of outside metal corners needed = ______________________________

ASSIGNMENT SHEET #2

PART III

Use your estimate of the total square footage of drywall required to determine the number of pieces of each size of drywall required. Assume that three-fourths of the material should be 4′ × 12′ × 1/2″ and the remainder 4′ × 8′ × 1/2″. How much of each size is required? Show your work in the space below and write the correct answers in the blanks.

A. 4′ × 12′ = ____________________ sheets

B. 4′ × 8′ = ____________________ sheets

DRYWALL
UNIT II

ANSWERS TO ASSIGNMENT SHEETS

(NOTE: These answers are only a reference guide. Due to variations in rounding and procedures, these assignment sheets must be evaluated to the satisfaction of the instructor.)

Assignment Sheet #1

A. 816

B. 5.11 or 5

C. 302

D. 65 (2 containers)

E. 3

Assignment Sheet #2

PART I

A. 758 square feet

B. 717 square feet

C. 1,360 square feet

D. 586 square feet

E. 697 square feet

F. 714 square feet

G. 832 square feet

PART II

A. 6,119

B. 6,119

C. 37 $\frac{1}{2}$ or 38

D. 2,220

E. 480 (10 containers)

F. 10

PART III

A. 96

B. 48

DRYWALL
UNIT II

JOB SHEET #1 — INSTALL GYPSUM WALLBOARD

I. Tools and materials

A. Tools

1. Drywall hatchet
2. Folding rule or steel tape
3. Nail pouch
4. Utility knife
5. Drywall square
6. Drywall saw
7. Wallboard jacks
8. Circle cutter
9. Drywall keyhole saw
10. Surform tool

B. Materials

1. Gypsum wallboard
2. Nails
3. Metal corners
4. 2×4s for ceiling Ts

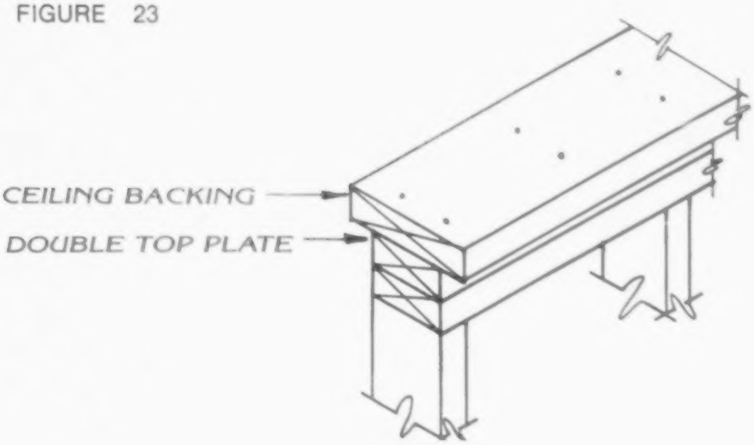
II. Procedure for ceiling installation

(NOTE: Ceiling wallboard should always be applied first, but before any wallboard is applied, be sure that electrical, water, gas, heating, and air-conditioning rough-in has been completed, that the inspection has been completed and approved, and that the exterior wall insulation has been installed.)

A. Preparing for installation

1. Install backing along top plate if it has not already been installed (Figure 23)

FIGURE 23

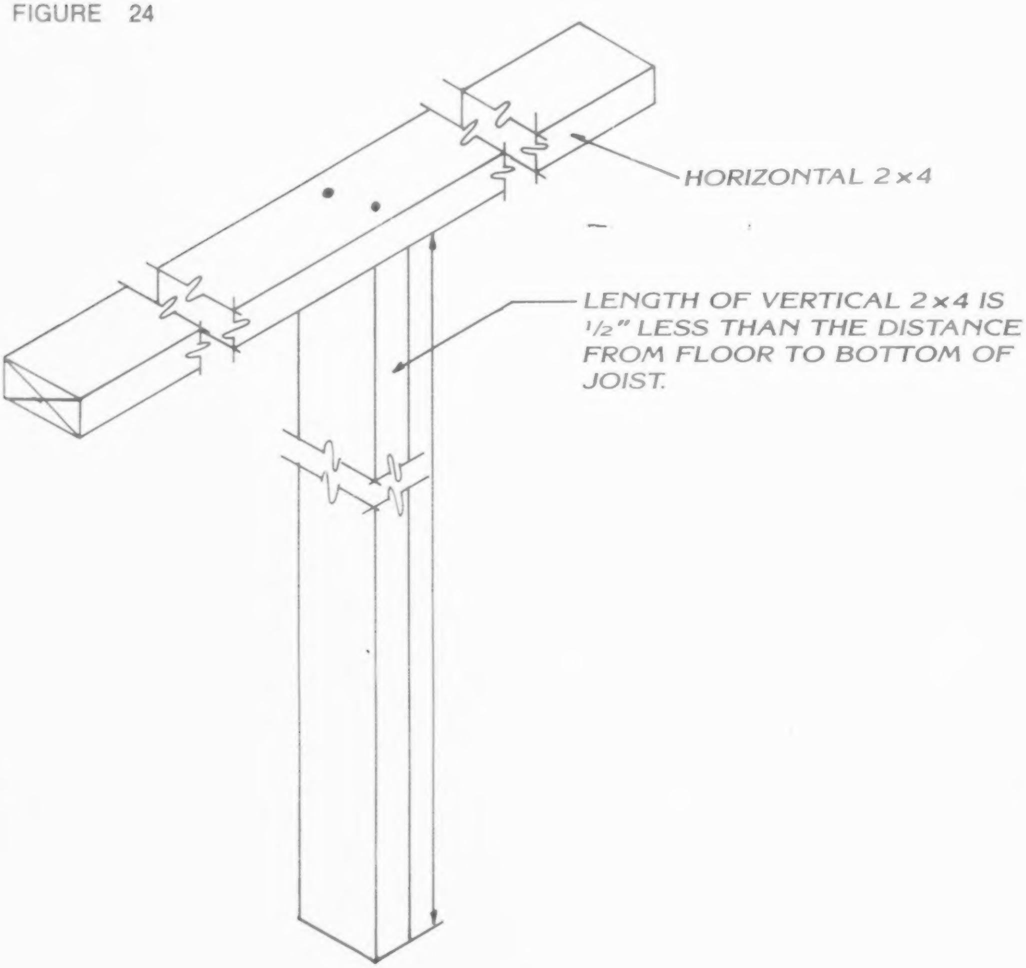


JOB SHEET #1

2. Construct two or more ceiling Ts from 2×4s, making the vertical member ½-inch shorter than the distance from the floor to the bottom of the joist (Figure 24)

   (NOTE: Ceiling Ts are used to support the ceiling wallboard during nailing.)

FIGURE 24

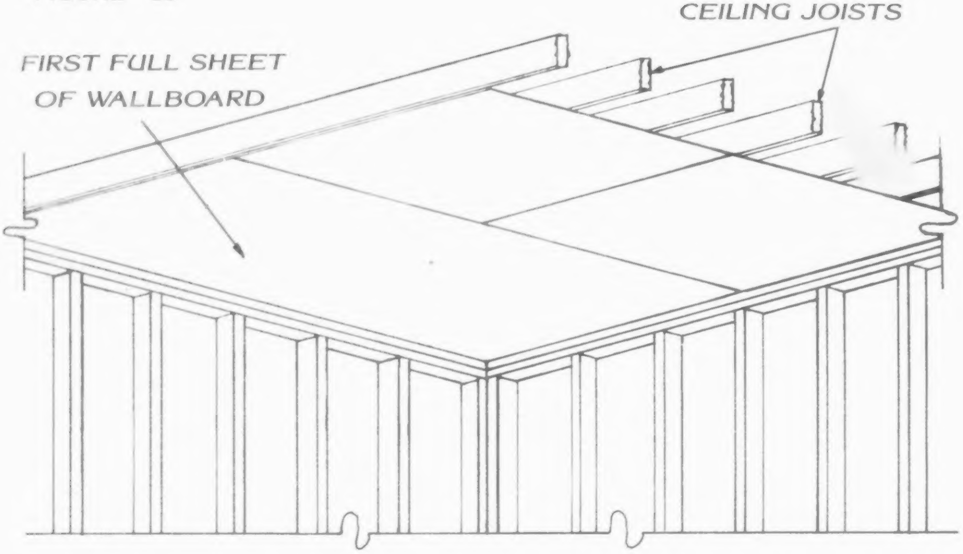

HORIZONTAL 2×4
LENGTH OF VERTICAL 2×4 IS ½" LESS THAN THE DISTANCE FROM FLOOR TO BOTTOM OF JOIST.

B. Installing first full sheet of ceiling wallboard

1. Beginning in a corner, position full sheet of wallboard at right angle to ceiling joists (See Figure 25)

JOB SHEET #1

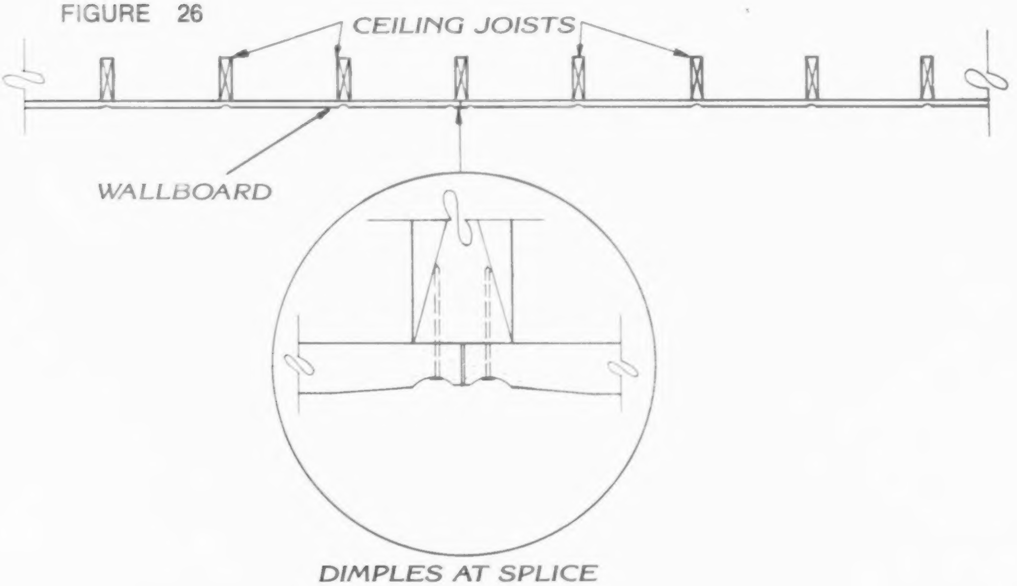
FIGURE 25


FIRST FULL SHEET OF WALLBOARD
CEILING JOISTS

2. Position ceiling Ts to support wallboard sheet and to hold it in place
3. Beginning at center of sheet and working outward, nail wallboard by driving nails flush and then striking once more to make a dimple (Figure 26)

(NOTE: Do not break the surface paper when nailing.)

FIGURE 26


CEILING JOISTS
WALLBOARD

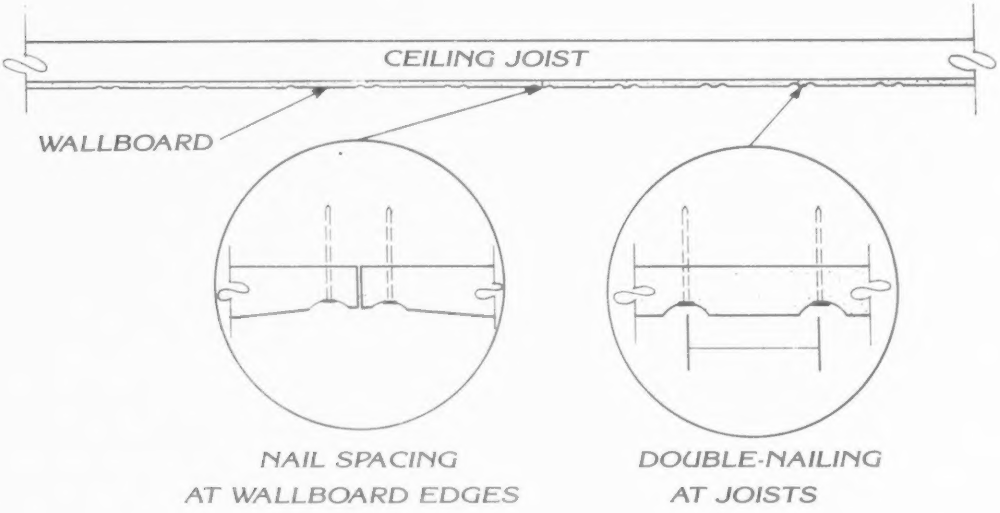
DIMPLES AT SPLICE

JOB SHEET #1

4. Double-nail sheet along joists by placing two nails 2 inches apart at 12-inch intervals (See Figure 27)

5. Nail one nail every 7 inches along wallboard edges (Figure 27)

FIGURE 27



C. Cutting and installing remaining ceiling wallboard

1. Measure ceiling and then subtract 1/8 inch from measured length

   (NOTE: Breaks must fall on joist or nail backing.)

2. Mark measurements on finished face of wallboard

3. Hold straightedge on marks and use sharp knife to cut through face paper

4. Break wallboard at cut

5. Use knife to cut paper on back side of wallboard

6. Use surform tool to smooth cut edge if necessary

7. Nail wallboard following procedures in steps B-2 through B-5 for installing first full sheet

D. Cutting openings for electrical boxes, switches, etc.

(NOTE: Openings should be no more than 1/8 inch larger than fixture.)

JOB SHEET #1

1. Measure distance of opening from the end and edge of wallboard
2. Mark measurement on face of wallboard
3. Outline opening with pencil
4. Cut out opening with keyhole saw

III. Procedure for wall installation

A. Installing first full sheet of wallboard in top row

1. Beginning in a corner, hold full sheet of wallboard tightly against ceiling wallboard
2. Beginning at center of sheet and working outward, nail wallboard by driving nails flush and then striking once more to make a dimple
3. Double-nail sheet along joists by placing two nails 2 inches apart at 12-inch intervals
4. Nail one nail every 8 inches along wallboard edges

B. Cutting and installing remaining wallboard in top row

(NOTE: Whenever possible, wallboard should be installed horizontally on walls. Plan installation so that vertical joints are above door and window openings whenever practical. See Figure 28. Also, joints should be at least 6 inches from end of headers to reduce cracking and joint treatment.)

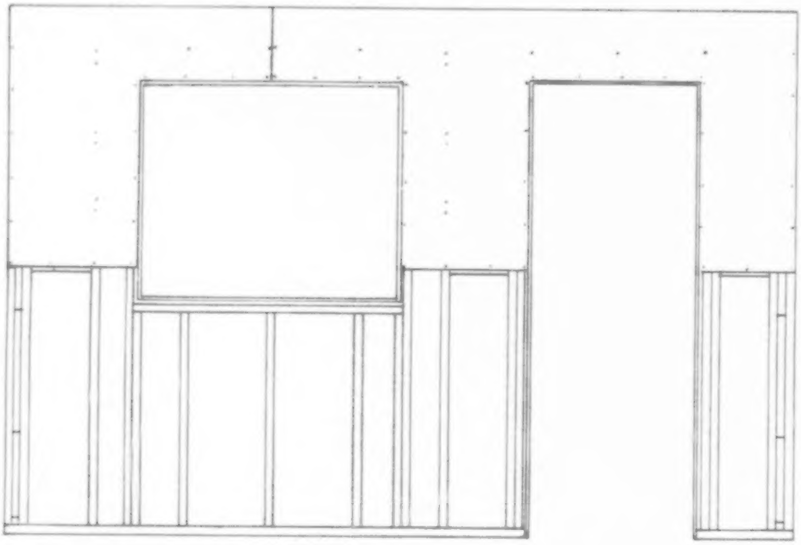
1. Measure wall and then subtract ⅛ inch from measured length
2. Mark measurements on finished face of wallboard

   (NOTE: Wallboard over door and window openings may be put in position and cut in place.)

3. Hold straightedge on marks and use a sharp knife to cut through face paper
4. Break wallboard at cut
5. Use knife to cut paper on back side of wallboard
6. Use surform tool to smooth cut edge if necessary
7. Nail wallboard following procedures in steps A-2 through A-4 for installing first full sheet (See Figure 28)

JOB SHEET #1

FIGURE 28

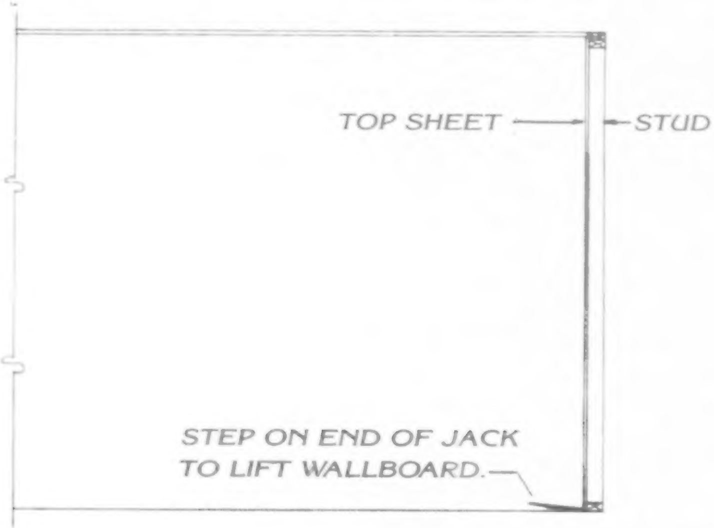


C. Cutting and installing wallboard in bottom row

1. Measure wall, mark measurements on wallboard, and cut wallboard, following steps B-1 through B-6

2. Position wallboard with wallboard jacks to lift and hold sheet tight against sheet in top row

FIGURE 29

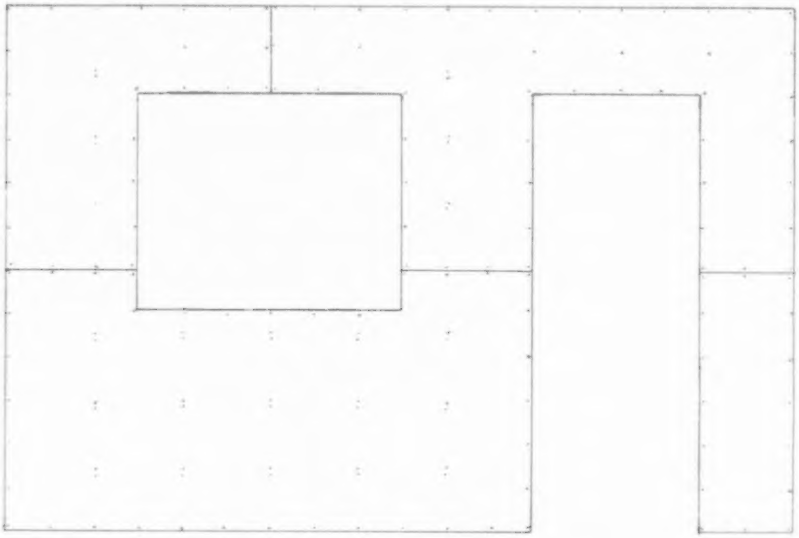

TOP SHEET
STUD
STEP ON END OF JACK
TO LIFT WALLBOARD.

JOB SHEET #1

3. Nail wallboard following procedures in steps A-2 through A-4 for installing first full sheet

4. Continue cutting and installing as required to complete wallboard installation (Figure 30)

FIGURE 30



IV. Procedure for installing metal corner beads

(NOTE: Metal corner beads are used only on outside corners.)

A. Measure length of outside corner

B. Cut metal corner bead to length if necessary

C. Position metal corner bead over outside corner and nail corner bead every 5 inches on both edges through wallboard into wood frame

D. Clean up area and put away tools and equipment

DRYWALL
UNIT II

JOB SHEET #2 — FINISH WALLBOARD JOINTS AND DEPRESSIONS

I. Tools and equipment

- A. Drywall hammer or hatchet
- B. Taping knife
- C. 4-inch and 10-inch finishing knives
- D. Mud pan
- E. Joint tape
- F. Joint compound
- G. Corner beads (when appropriate)
- H. Nails for corner beads or crimping tool
- I. Sander and sandpaper

II. Procedure

- A. Prepare walls for bedding and taping
    1. Install all corner beads, nailing every 5 inches through the drywall and into the framing
    2. Make a quick check to be sure all nails are set with proper dimples; correct as necessary
- B. Bed and tape joints
    1. Straight joints
        - a. Fill with joint compound channel formed by tapered edges of drywall sheets
        - b. Center tape directly over joint and embed tape by pressing it firmly into compound with knife
        - c. Smooth compound around and over tape to form level surface

          (NOTE: Some compound should be squeezed from under the tape, but leave enough to form a good bond.)

JOB SHEET #2

2. Inside-corner joints

   a. Fold joint tape down the middle

   b. Apply compound to both sides of corner

   c. Press creased tape into corner with knife

   d. Smooth out compound on both sides of corner

C. Fill nail depressions

1. Apply compound

2. Draw knife across dimple with an even, smooth pressure

3. Turn knife at a right angle to first application and draw it back across depression to smooth compound level with surface of drywall

D. Apply compound over bead flange of corner beads and out from the bead 4 to 6 inches

E. Finish joints, nail depressions, and corner beads

1. After drying at least twenty-four hours, lightly sand all areas where compound was applied

   (NOTE: Do not damage the face of the drywall.)

2. Apply thin coat of compound over all areas previously coated, feathering out edges 1½ to 3 inches beyond edges of first coat

3. Let compound dry for at least twenty-four hours, and then sand lightly

4. Apply another coat of compound over all areas previously coated, feathering out edges to a total width of 14 to 18 inches

5. Let compound dry for at least twenty-four hours, and then sand lightly

   (NOTE: Conditions such as temperature and humidity may make it necessary to apply additional coats for a smooth surface. Follow the procedures in steps 4 and 5 if additional coats are required.)

6. Clean up area and put away tools and equipment

DRYWALL
UNIT II

JOB SHEET #3 — APPLY LAMINATED GYPSUM WALLBOARD

I. Tools and materials

   A. Tools

      1. Drywall hammer
      2. Utility knife
      3. Carrier lifter
      4. Drywall lifter
      5. Drywall and keyhole saws
      6. Drywall T-square
      7. Drywall screwdriver
      8. Rubber mallet
      9. Sawhorses
      10. Caulking gun

   B. Materials

      1. Gypsum wallboard (backer board)
      2. Gypsum wallboard (recessed edge)
      3. Screws
      4. Adhesive

II. Procedure

   A. Install base layer (backer board)

   (NOTE: Stagger panels on opposite side of wall so that joints occur on different studs.)

      1. Position panel with long length placed vertically

      (NOTE: When using vinyl panels for face layer, install base layer horizontally.)

      2. Center edge of panel on stud
      3. Screw panel to stud

JOB SHEET #3

(NOTE: Screw spacing for adhesive laminated face should be 8 inches on center at joints and 12 inches on center in the field.)

4. Continue installing panels, repeating steps A-1 through A-3 until base layer is complete

B. Install face panel

1. Cut panel for length

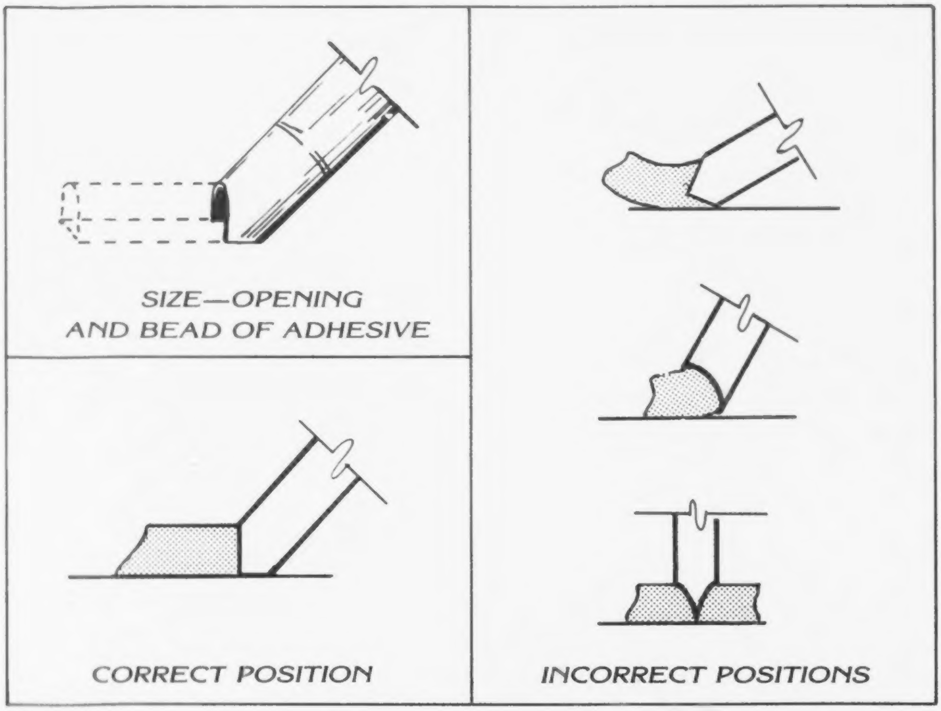
   (NOTE: Face panel will be installed horizontally.)

2. Lay panel on sawhorses with back side up

3. Spread adhesive on panel using caulking-gun or spreader method (Figures 31 and 32)

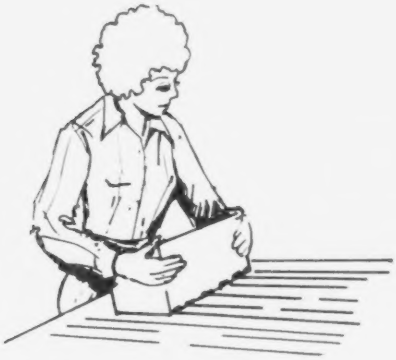
   (NOTE: When using a caulking gun, adhesive beads should be $^{3}/_{8}$ inch wide by $^{1}/_{2}$ inch high and maximum of 2 inches on center.)

FIGURE 31: Caulking-gun method


SIZE—OPENING AND BEAD OF ADHESIVE
CORRECT POSITION
INCORRECT POSITIONS

JOB SHEET #3

FIGURE 32: Spreader method

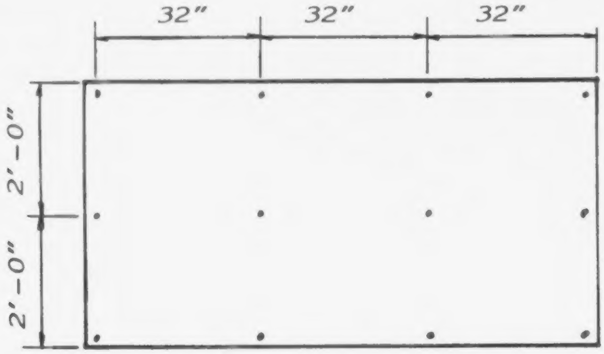


4. Position top panel on base panel horizontally

5. Temporarily nail panel and impact entire area with a rubber mallet to assure good bond

6. Screw panel to studs, using pattern shown in Figure 33 (Figure 33)

FIGURE 33



7. Impact entire area with a rubber mallet to assure bond

8. Nail panel to studs (wood studs)
   a. Nail panels on edge where tape will cover
   b. Drive temporary nails in field of panel

JOB SHEET #3

(NOTE: Duplex nails or scraps of gypsum wallboard and any smooth nail long enough may be used to penetrate the stud.)

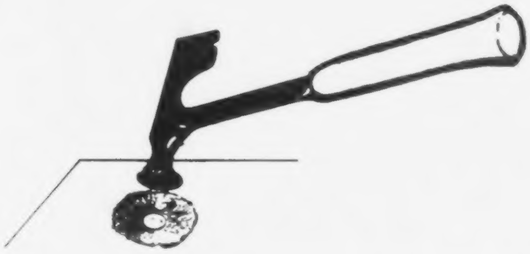
c. Leave temporary nailing for twenty-four hours

9. Place a block of wood under hammer and remove temporary nailing

(NOTE: Do not break face paper.)

10. Dimple nail hole with drywall hammer (Figure 34)

FIGURE 34



C. Clean up area and put away tools and materials

DRYWALL
UNIT II

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with drywall to their correct definitions. Write the correct numbers in the blanks.

_____a. Compound used to embed perforated tape to wallboard joints, to finish over tape and corner bead, and to finish over nail and screw heads

_____b. Paper tape used as reinforcement at wallboard joints to keep surface from cracking

_____c. Pattern used when two nails are spaced 2 inches apart every 12 inches; pattern used on intermediate joists and studs

_____d. Rigid sheathing material made with a noncombustible core (usually gypsum) that is surfaced with treated paper or some other sheet material; sheathing material applied to interior finish walls and ceilings

_____e. Finish coat of compound that covers all previous coats

_____f. Strips of wood nailed on top of top plate between joists and at inside wall angles of partitions; provides a solid base for nailing wallboard

_____g. Joint compound applied to depression formed by butt joints and tapered wallboard edges

_____h. Place where edges of two pieces of wallboard meet

_____i. Any rigid sheathing material applied to interior finish walls and ceilings

_____j. Impression on wallboard surface formed by a nail driven to proper depth

_____k. To make by uniting two or more layers of material

_____l. Compound specially blended to set in from 20 to 90 minutes; is used almost exclusively in constructing manufactured housing

_____m. To spread joint compound or topping so that it tapers to a thin edge

1. Drywall
2. Wallboard
3. Backing
4. Joint
5. Perforated tape
6. Joint compound
7. Bedding
8. Topping
9. Featheredge
10. Quick-weld compound
11. Dimple
12. Double nailing
13. Laminate

TEST

2. Name five types of gypsum wallboard.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

3. Select from the following list standard sizes of gypsum wallboard. Write an "X" in the blank before each correct answer.

_____a. 1/2 inch thick

_____b. 6 feet wide

_____c. 4 feet long

_____d. 5/8 inch thick

_____e. 1 inch thick

_____f. 1/4 inch thick

_____g. 16 feet long

_____h. 5 feet long

_____i. 4 feet wide

_____j. 1 1/4 inches thick

_____k. 8 feet long

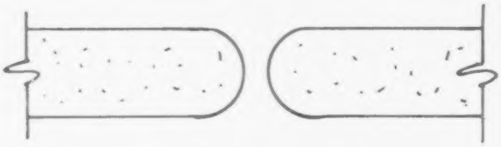
_____l. 12 feet long

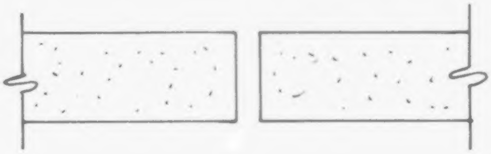
_____m. 3/8 inch thick

_____n. 10 feet long

4. Identify the standard edge shapes of gypsum wallboard illustrated below and on the following page. Write the correct names in the blanks.

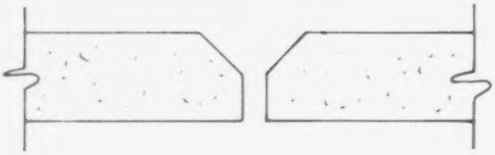
Tongue and groove (T & G) **Beveled** **Tapered** **Round** **Square**



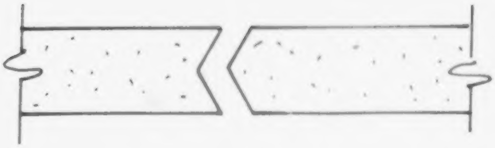


a. ______________________ b. ______________________

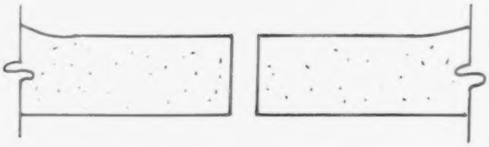
TEST



c. ________________________________



d. ________________________________



e. ________________________________

5. State four benefits of using gypsum wallboard.

   a. ________________________________

   b. ________________________________

   c. ________________________________

   d. ________________________________

6. Describe three types of base or construction where wallboard is used.

   a. ________________________________

   ____

   b. ________________________________

   ____

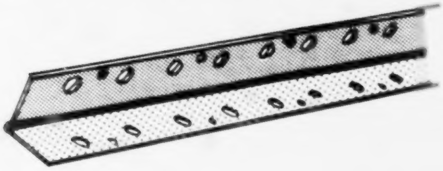
   c. ________________________________

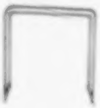
   ____

TEST

7. Identify the following illustrations of hardware and fasteners used with gypsum wallboard. Write the correct names in the blanks. Some answers will be used more than once.

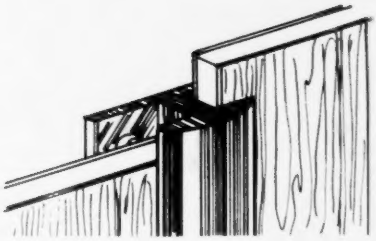
Outside-corner molding for predecorated wallboard
Phillips-head screw
Coated nail
Annular-ring nail
Divider molding for predecorated wallboard
Metal casing bead
Expansion joint
Staple
Metal corner bead
Flex-tape corner

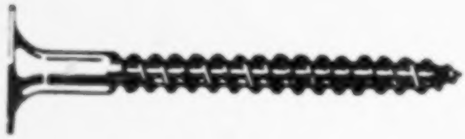




a. ______________________

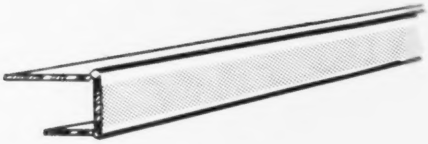
b. ______________________

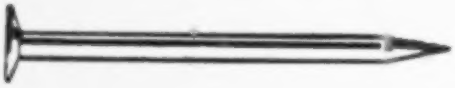




c. ______________________

d. ______________________

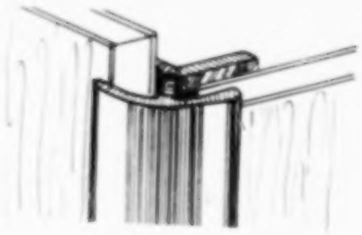




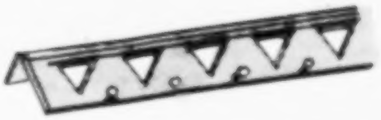
e. ______________________

f. ______________________

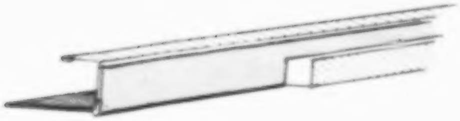
TEST



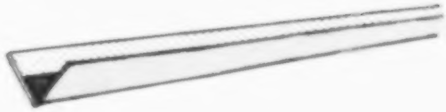
g. ______________________________



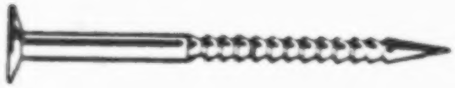
h. ______________________________



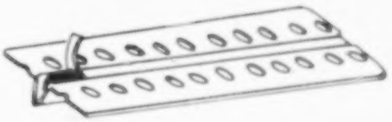
i. ______________________________



j. ______________________________



k. ______________________________



l. ______________________________

8. Select from the following list types of finishes that may be applied to gypsum wallboard. Write an "X" in the blank before each correct answer.

______a. Acoustical tile

______b. Paneling

______c. Quarry tile

______d. Texture

______e. Paint

______f. Plaster

______g. Predecorated finishes

______h. Ceramic tile

______i. Wallpaper

______j. Plastic laminate

TEST

9. Using the floor plan below and the table on the following page, estimate the materials needed to dry wall the room's walls and ceiling. Write the correct answers in the blanks. Show your work.

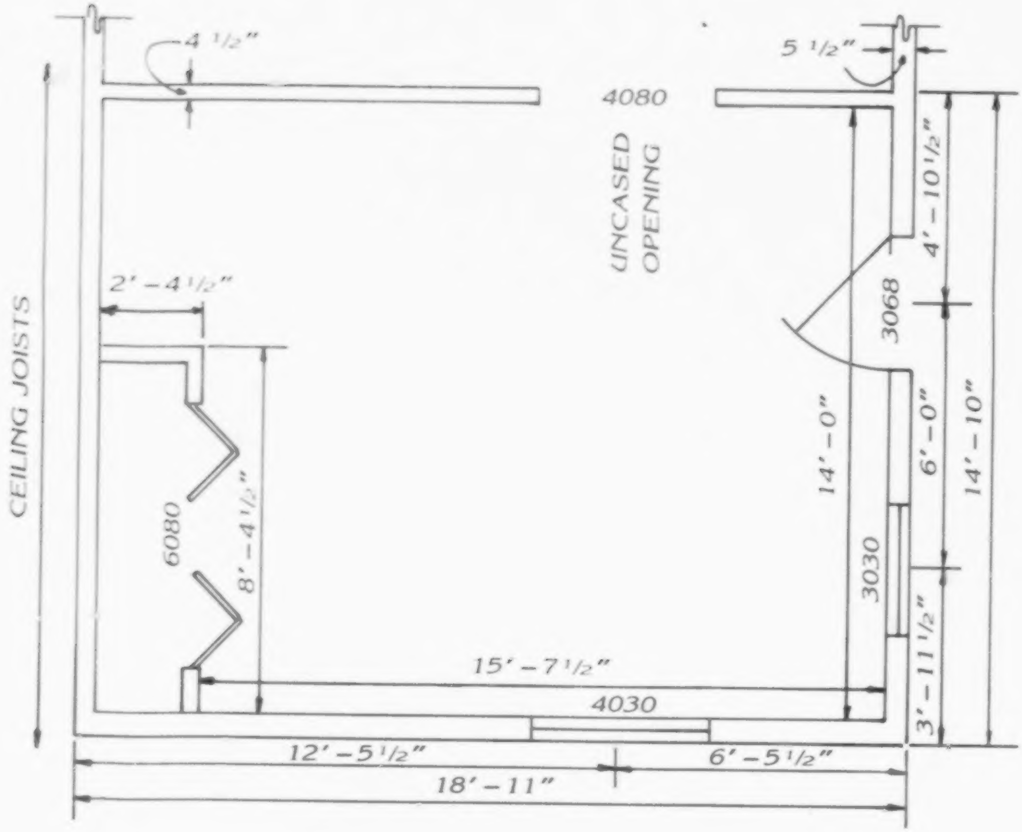
   a. Square feet of ½-inch gypsum wallboard needed = ____________________

   b. Pounds of 1¼-inch drywall screws needed = ____________________

   c. Feet of perforated tape needed = ____________________

   d. Amount of joint compound needed = ____________________

   e. Number of outside metal corners (8-foot length) needed = ____________________


4 1/2"
5 1/2"
4080
UNCASED OPENING
4'-10 1/2"
3068
14'-10"
2'-4 1/2"
CEILING JOISTS
6080
8'-4 1/2"
14'-0"
6'-0"
3030
3'-11 1/2"
15'-7 1/2"
4030
12'-5 1/2"
6'-5 1/2"
18'-11"

TEST

Fastening and Finishing Materials Required for 1,000 Square Feet of Wallboard

Material	Amount
1¼" annular-ring nail	6¼ lb
1⅜" annular-ring nail	6¾ lb
1" drywall screw	3 lb
1¼" drywall screw	4¼ lb
1⅝" drywall screw	5½ lb
Ready-mix joint compound	80 lb (50-lb container)
Dry joint compound	50 lb (25-lb bag)
Perforated tape	370 lin ft
Texture paint	10 lb to 50 lb (25-lb bags)

(NOTE: Test question 10 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

10. Demonstrate the ability to

    a. Install gypsum wallboard.

    b. Finish wallboard joints and depressions.

    c. Apply laminated gypsum wallboard.

DRYWALL
UNIT II

ANSWERS TO TEST

1. a. 6
   b. 5
   c. 12
   d. 2
   e. 8
   f. 3
   g. 7
   h. 4
   i. 1
   j. 11
   k. 13
   l. 10
   m. 9

2. Answer should include any five of the following

   a. Regular
   b. Type "X"
   c. Insulating
   d. Backing board
   e. Core board
   f. Fire code
   g. Waterproof
   h. Predecorated

3. a, c, d, e, f, g, i, k, l, m, n

4. a. Round
   b. Square
   c. Beveled
   d. Tongue and groove (T & G)
   e. Tapered

5. Answer should include any four of the following

   a. Is easily applied
   b. Is economical
   c. Is easily maintained
   d. Is easily repaired
   e. Is noncombustible
   f. Provides a good base for applying finish materials

6. Answer should include any three of the following

   a. Single layer applied to wood framework
   b. Single layer applied to metal framework
   c. Single layer applied directly to masonry walls
   d. Single layer applied to wood or metal furring strips
   e. Single layer used as subflooring
   f. Double layer (two-ply) nailed, screwed, or laminated to base layer

7. a. Metal corner bead
   b. Staple
   c. Divider molding for predecorated wallboard
   d. Phillips-head screw
   e. Metal casing bead
   f. Coated nail
   g. Outside-corner molding for predecorated wallboard
   h. Metal corner bead
   i. Metal casing bead
   j. Flex-tape corner
   k. Annular-ring nail
   l. Expansion joint

ANSWERS TO TEST

8. a, b, d, e, g, h, i

9. (NOTE: Because estimating answers will vary considerably, answers should be evaluated to the satisfaction of the instructor.)

   a. 752 or 914
   b. $3\frac{1}{4}$ or 4
   c. 278 or 338
   d. 60 or 73 (2 containers)
   e. 3 or 5

10. Performance skills evaluated to satisfaction of the instructor

INTERIOR WALLS AND CEILINGS
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to recognize the different types of wall and ceiling finish materials and be able to install various types of materials using various installation methods. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with wall and ceiling finishes.
2. List materials used to finish walls and ceilings.
3. Name styles of paneling.
4. Identify joint treatments for paneling.
5. Estimate the number of 4′ × 8′ sheets needed to panel a room.
6. List materials used to fabricate ceiling tile.
7. List factors that influence type of ceiling tile to be used.
8. Estimate the number of ceiling tiles needed to finish a ceiling.
9. Demonstrate the ability to
    a. Install V-grooved paneling and trim.
    b. Install panel wainscot and trim.
    c. Install furring strips on a masonry wall.
    d. Install ceiling tile over drywall.
    e. Install furring strips on ceiling joists and ceiling tile on furring.

INTERIOR WALLS AND CEILINGS
UNIT III

SUGGESTED ACTIVITIES

I. Unit contents

  A. Objective sheet

  B. Suggested activities

  C. Supplement #1 — Methods Used to Install Wall and Ceiling Materials

  D. Information sheet

  E. Job sheets

    1. Job Sheet #1 — Install V-Grooved Paneling and Trim

    2. Job Sheet #2 — Install Panel Wainscot and Trim

    3. Job Sheet #3 — Install Furring Strips on a Masonry Wall

    4. Job Sheet #4 — Install Ceiling Tile over Drywall

    5. Job Sheet #5 — Install Furring Strips on Ceiling Joists and Ceiling Tile on Furring

  F. Test

  G. Answers to test

II. Instructor's guide

  A. Review unit and plan presentation.

  B. Obtain materials to supplement unit.

    1. Photographs of rooms with a creative use of wall finishes

    2. Samples of materials used to finish walls and ceilings

    3. House plans and schedules showing wall-finishing requirements

    4. Samples of materials used to fabricate ceiling tiles

    5. House plans for students to use in estimating the number of ceiling tiles needed to finish a ceiling

    6. Transparencies and competency profiles

SUGGESTED ACTIVITIES

(NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W. Washington, D.C. 20006, phone 202-393-2040.)

C. Introduce unit.

SUGGESTIONS:

- Have an interior decorator or a home economist with expertise in home furnishings talk to the class about the effects that can be achieved by the conscious application of interior-design principles to wall and ceiling finishes.
- Have the class think about the walls and ceilings in homes, restaurants, offices, etc., that they have visited. Discuss the role of wall finishes in creating a particular atmosphere — such as deeply textured wood paneling to convey a sense of luxury or masculinity or a thick plaster to capture a Spanish atmosphere.
- Display photographs of rooms making creative use of wall finishes, especially thoses combining two or more application techniques. Discuss the use of wall and ceiling finishes to achieve an effect.

D. Provide students with objective sheet.

E. Discuss unit and specific objectives.

F. Provide students with information and job sheets.

G. Discuss information and job sheets.

1. Use Information Sheet, Section I to discuss terms and definitions associated with interior wall and ceiling finishes.

   SUGGESTION:

   - Provide students with actual samples of materials and tools if possible.

2. Use Information Sheet, Section II to discuss materials used to finish walls and ceilings.

   SUGGESTIONS:

   - Have a representative from a manufacturer or distributor of wall and ceiling finish materials talk to the class about types of materials used.

SUGGESTED ACTIVITIES

- Display samples of the various finish materials discussed in this section of the information sheet.

- Use Supplement #1 to discuss the methods used to install wall and ceiling finish materials.

3. Use Information Sheet, Sections III and IV to discuss styles of paneling and joint treatments for paneling.

   SUGGESTION:

   - Take the class to visit a paneling manufacturer or distributor to see the various styles of paneling and to obtain information about uses, costs, and availability of the various styles of paneling.

4. Use Information Sheet, Section V to discuss estimating the number of 4′ × 8′ sheets needed to panel a room.

   SUGGESTIONS:

   - Point out that the steps described in the information sheet are strictly for use with 4′ × 8′ sheets with walls of not much more than 8′–0″; review previously learned estimating techniques and relate them to specific wall finish materials.

   - Provide students with house plans and schedules and have them estimate wall finish material requirements.

   - Demonstrate the procedures in Job Sheets #1 through #3

     (NOTE: These procedures are written to provide practice with a number of materials and application techniques. You may want to emphasize materials and practices common in your area.)

   - Have students complete Job Sheets #1 through #3.

5. Use Information Sheet, Sections VI and VII to discuss materials used to fabricate ceiling tiles and factors that influence the type of ceiling tile to be used.

   SUGGESTIONS:

   - Display samples of the various types of fabrication materials, and discuss the applications of each. Relate the various materials to the factors that influence the selection of a tile.

   - Have a representative from a manufacturer or distributor of ceiling tile discuss the product with the class.

SUGGESTED ACTIVITIES

6. Use Information Sheet, Section VIII to discuss estimating the number of ceiling tiles needed to finish a ceiling.

   SUGGESTIONS:

   - Provide students with plans and have them estimate materials and costs for a plan using various sizes and styles of ceiling tile.
   - Demonstrate the procedures in Job Sheets #4 and #5.
   - Have students complete Job Sheets #4 and #5.

H. Review unit.

I. Give test.

J. Critique test and discuss in class.

K. Reteach if necessary.

L. Complete appropriate sections of competency profiles.

III. Unit references

A. Hendrix, Laborn J. "Bud." *Commercial Carpentry.* Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1979.

B. Wagner, Willis H. *Modern Carpentry.* South Holland, Illinois: The Goodheart-Willcox Company, 1976.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — METHODS USED TO INSTALL WALL AND CEILING MATERIALS

Material*	Location	Method
Plaster	Wall or ceiling	Applied by hand or machine over lath or backing
Drywall	Wall	Attached to studs by nails, screws, staples, or adhesive
		Attached to furring strips over masonry walls
	Ceiling	Attached to joists with nails or screws
		(NOTE: An exposed-beam appearance can be created with drywall by installing solid, built-up, or false beams over the drywall.)
Tile		
Ceramic	Wall or ceiling	Applied with adhesive or in a base material such as grout
Acoustical	Wall	Applied directly to drywall with nails, staples, or adhesive
	Ceiling	Usually attached to furring strips
		Laid in a metal framework for suspended ceilings
Solid lumber	Wall or ceiling	Nailed with exposed nails or blind nailing directly to framing members, drywall, or furring strips
Selected tongue-and-groove lumber	Ceiling	Applied directly to roof beams
		(NOTE: This is called *exposed beam and deck construction* and requires careful use of vapor barriers and, generally, rigid insulation between the deck and roofing.)
Paneling	Wall	Fastened to studs, drywall, or furring strips with nails or adhesive
		(NOTE: Nails may match color of paneling and installation may or may not include molding.)
Plastic laminate	Wall	Bonded to drywall with adhesive or manufactured with fiberboard or particle-board base

*The materials listed are those that generally require installation or special preparation by the carpenter.

INTERIOR WALLS AND CEILINGS
UNIT III

INFORMATION SHEET

I. Terms and definitions associated with wall and ceiling finishes

   A. Plaster — Mixture of lime, cement, and sand applied to walls and ceilings to finish their surfaces

   B. Drywall — Hardboard (usually with gypsum core) used to cover walls and ceilings

   C. Plastic laminate — Thin sheet of hard, smooth, synthetic material that is highly resistant to scratching and wear; used for wainscoting and wall paneling

   D. Wainscot — Material that covers lower part of an interior wall surface and contrasts with wall surface above

   E. Furring — Strips of wood or metal applied to surface to make it straight and plumb and to provide fastening surface for finish covering

   F. Adhesive — Glue, cement, mastic, paste, or any substance capable of holding materials together by surface attachment

   G. Scribe — Tool with a sharp point used to make irregular marks for cutting and fitting a piece of material

   H. Putty stick — Material used to fill holes in finished surface; is color-coded to match finished surface

   I. Cap molding — Trim nailed to wall at top edge of wainscoting

   J. Cope — To cut or shape the end of a piece of molding so that it will fit the contour of an adjoining piece of molding

   K. Lath — Metal, wood, or gypsum panel nailed to stud as backing or base for plaster

II. Materials used to finish walls and ceilings

   (NOTE: A number of other methods exist for finishing walls and ceilings, such as paint and wallpaper. The ones listed here are most likely to be applied by the carpenter or are most likely to require preparation by the carpenter.)

   A. Walls

      1. Plaster
      2. Drywall
      3. Ceramic tile
      4. Solid-lumber paneling
      5. Plywood paneling
      6. Plastic laminate
      7. Hardboard paneling

INFORMATION SHEET

B. Ceilings

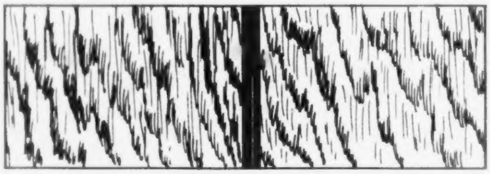
1. Plaster
2. Drywall
3. Drywall with exposed beams
4. Ceiling tile
5. Exposed roof-deck and beams

III. Styles of paneling (Figures 1-3)

A. V-grooved

EXAMPLE:

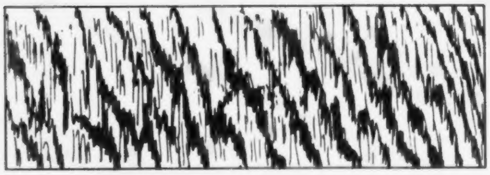
FIGURE 1



B. Plain

EXAMPLE:

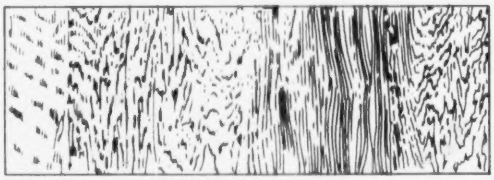
FIGURE 2



C. Brushed

EXAMPLE:

FIGURE 3

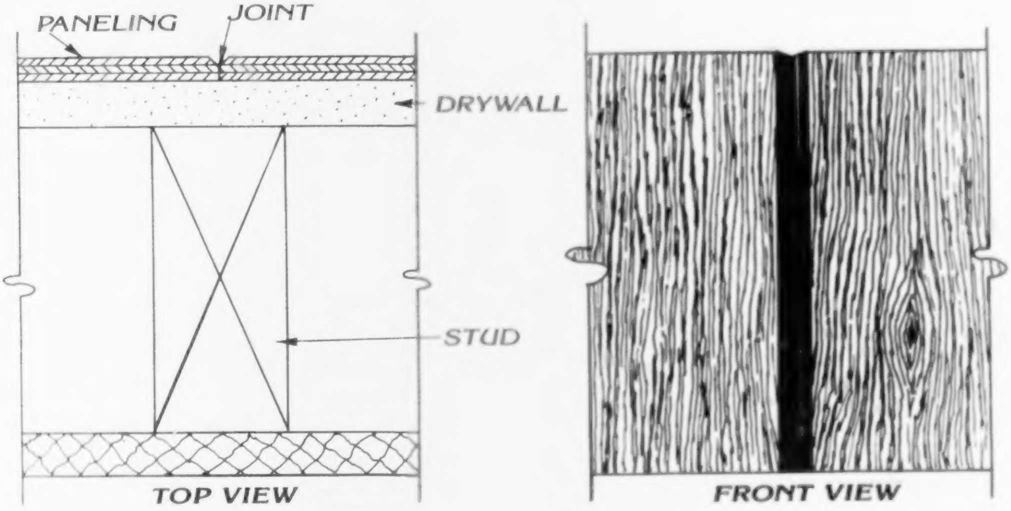


INFORMATION SHEET

IV. Joint treatments for paneling (Figures 4-6)

A. Butt joint with V-groove

FIGURE 4

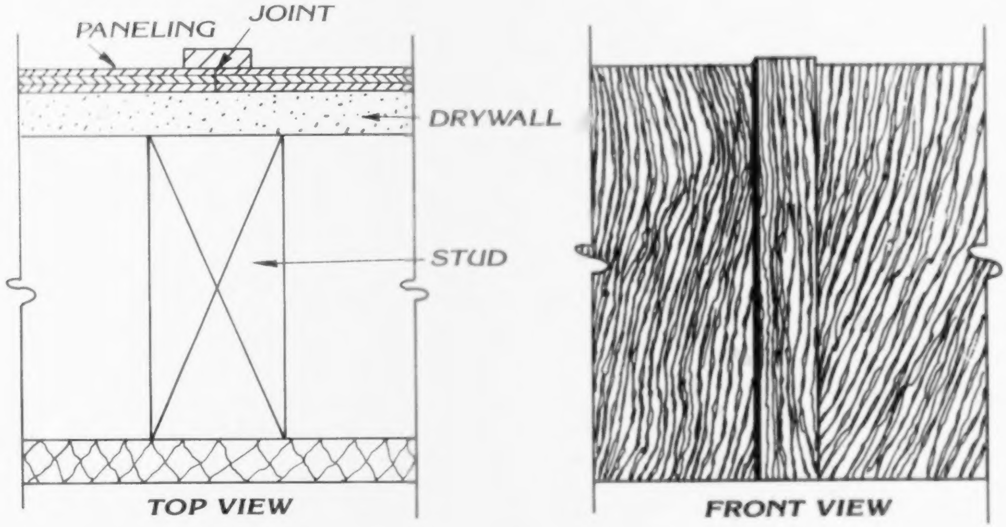

PANELING
JOINT
DRYWALL
STUD

TOP VIEW

FRONT VIEW

B. Batten strip

FIGURE 5


PANELING
JOINT
DRYWALL
STUD

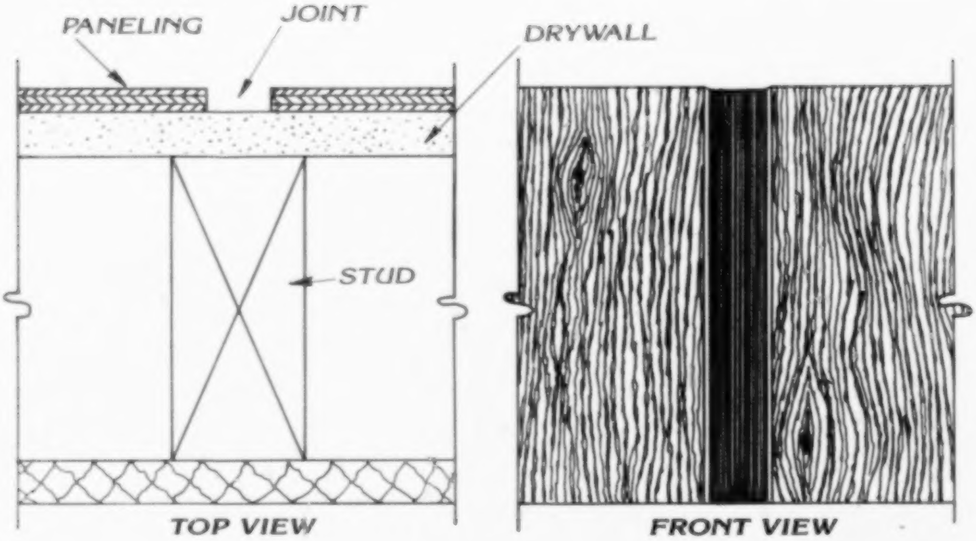
TOP VIEW

FRONT VIEW

INFORMATION SHEET

C. Open joint

FIGURE 6



V. Estimating the number of 4' × 8' sheets needed to panel a room

(NOTE: The procedure described below is a guideline for determining the number of 4' × 8' sheets needed to panel interior walls that are 8 feet high or less. For panels in other sizes, follow the procedures in steps A through C and then divide by the coverage provided by each unit of material. Also, when estimating perimeters, figure to the next largest full foot, if necessary.)

A. Check plans or measure to determine perimeter length of each wall

B. Check plans or measure to determine perimeter length of partitions and offset walls, if any

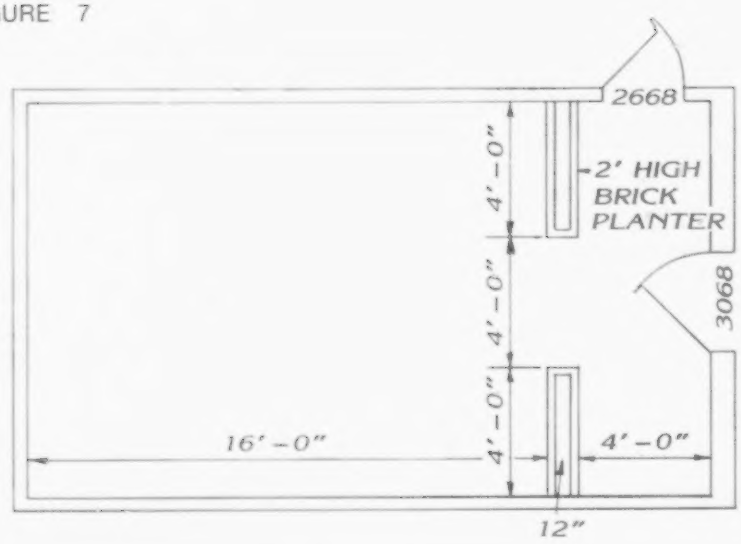
C. Add perimeters of all walls to find total perimeter

EXAMPLE: If the perimeters of the walls of a room are 21 feet, 12 feet, 21 feet, and 12 feet (See Figure 7), then

21'
12'
21'
12'
66' = total perimeter

INFORMATION SHEET

FIGURE 7



D. Divide total perimeter by 4 to find the number of 4' × 8' sheets needed; round up to next whole number if necessary

EXAMPLE: If the total perimeter of a room is 66 feet, then

66' ÷ 4' = 16½ or 17 sheets needed to panel room

VI. Materials used to fabricate ceiling tile

(NOTE: Ceiling tiles are manufactured in various sizes, surface patterns, and textures.)

A. Fiberboard

B. Mineral

C. Perforated metal

D. Glass fiber

E. Mirror

VII. Factors that influence type of ceiling tile to be used

A. Appearance

B. Initial cost

C. Ease of installation

D. Light reflection

E. Fire resistance

F. Sound absorption

G. Maintenance cost

H. Insulation value

INFORMATION SHEET

VIII. Estimating the number of ceiling tiles needed to finish a ceiling

A. Check plans or measure to find length and width of room

B. Round dimensions up to next whole foot, if necessary

EXAMPLE: If the room's actual measurements are 13′ – 8″ × 29′ – 4″, then use 14′ × 30′ when you are estimating.

C. Multiply length times width to find square footage of ceiling to be tiled

EXAMPLE: If a room's measurements are 14 feet × 30 feet, then

14′ × 30′ = 420 sq ft of ceiling to be tiled

D. Check packaging or measure to determine number of square feet covered by each tile

E. Divide square footage of ceiling to be tiled by square feet covered per tile to find number of tiles needed

EXAMPLE #1: If there are 420 square feet of ceiling and each 12″ × 12″ tile will cover 1 square foot, then

420 ÷ 1 = 420 tiles needed to finish ceiling

EXAMPLE #2: If there are 420 square feet of ceiling and each 12″ × 24″ tile will cover 2 square feet, then

420 ÷ 2 = 210 tiles needed to finish ceiling

INTERIOR WALLS AND CEILINGS
UNIT III

JOB SHEET #1 — INSTALL V-GROOVED PANELING AND TRIM

I. Tools and equipment

A. Folding rule or steel tape

B. 4-foot or 6-foot level

C. Hammer

D. Scribe

E. Framing square

F. Nail sets

G. Block plane

H. Power handsaw and extension cord

I. Power jigsaw

J. V-grooved paneling

K. Inside corners

L. Outside corners

M. Base

N. Putty stick

O. 3d and 4d finish nails

P. One pair of sawhorses

Q. Adhesive and manufacturer's instructions

II. Procedure for installing paneling

(NOTE: Before starting application, be sure paneling has been stored in room at least twenty-four hours prior to installation.)

A. Stand paneling on end around room and arrange so that adjoining panels match as to grain patterns, color, and groove spacing

B. Fit first panel

1. Align one edge of panel at inside corner and leading edge over a stud

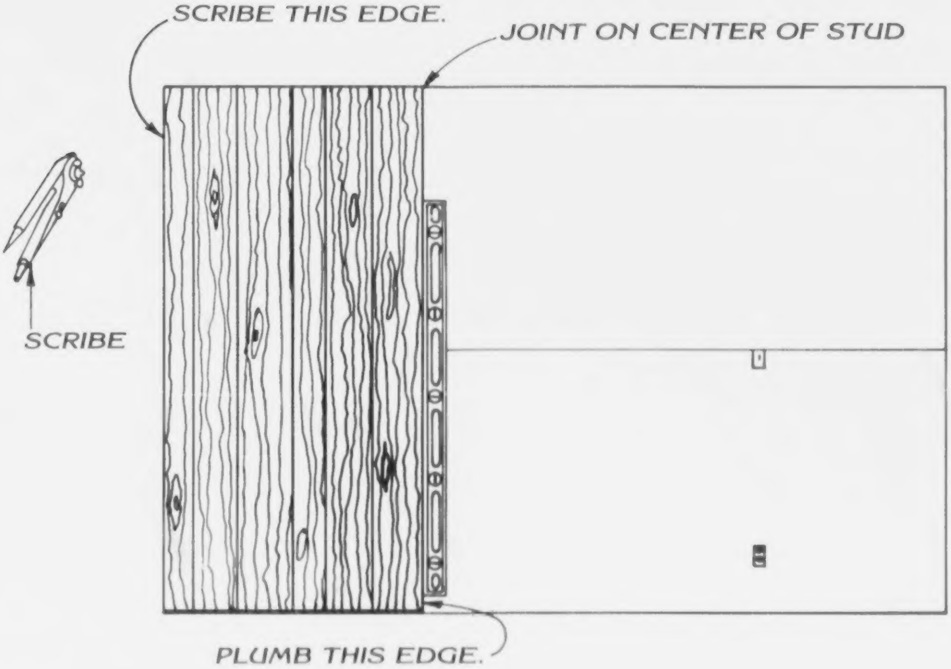
(NOTE: The edge opposite the starting point is called the *leading edge*. All joints must fall on studs. See Figure 8.)

JOB SHEET #1

2. Plumb leading edge of panel (See Figure 8)

3. Scribe inside-corner edge (Figure 8)

FIGURE 8


SCRIBE THIS EDGE.
JOINT ON CENTER OF STUD
SCRIBE
PLUMB THIS EDGE.

4. Place panel on sawhorses and trim to scribed mark

C. Fit remaining panels

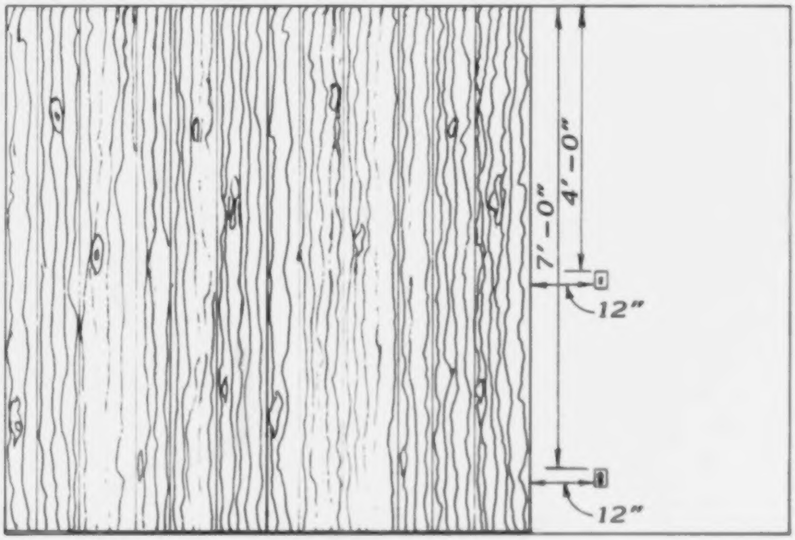
1. Align panels with sides of door and window openings whenever possible to conserve material

2. Measure and lay out cutouts for switches and receptacles

   a. Measure for cutouts from top of each panel and from leading edge of previous panel (See Figure 9)

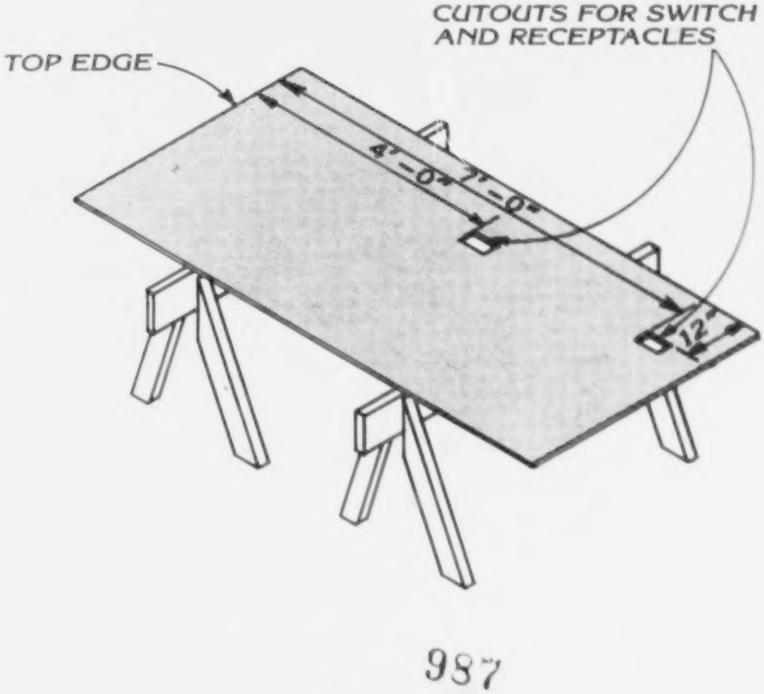
JOB SHEET #1

FIGURE 9



b. Mark and cut holes on back side of panel (Figure 10)

FIGURE 10


CUTOUTS FOR SWITCH AND RECEPTACLES
TOP EDGE
4'-0"
7'-0"
12"

JOB SHEET #1

c. Scribe and cut panels to fit corners

D. Color joints if desired

(NOTE: Some carpenters like to color the backing material at each joint with marker, shoe polish, or paint to prevent any of the backing material from showing at joints.)

E. Install panels, using nailing method or adhesive method

1. Nailing method

a. Beginning at top and working down, nail paneling with 16-inch spacing along each stud

b. Drive nails nearly flush and then set nails

c. Fill nail holes using putty stick if required

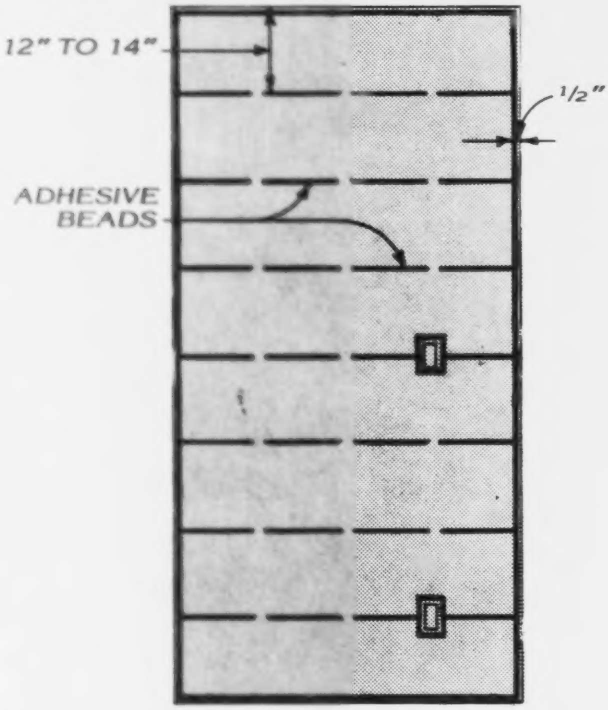
2. Adhesive method

(NOTE: Follow manufacturer's instructions when instructions differ from following procedure.)

a. Apply a continuous bead about 1/2 inch from edge (See Figure 11)

b. Beginning at top of panel, apply a row of four 6- to 8-inch long beads about every 12 to 14 inches down panel (Figure 11)

FIGURE 11



JOB SHEET #1

c. Press panel to wall

d. After recommended drying time, pull panel from wall at bottom edge and then press panel firmly back into position

(NOTE: This procedure will assure adherence.)

e. Sparingly nail panel if necessary

III. Procedure for installing trim

(NOTE: Paneling is normally trimmed *after* the doors and windows have been trimmed. For those procedures, see Unit IV, "Interior Doors and Trim." Also, paneling is sometimes used for window returns with outside-corner molding at the joints.)

A. Install floor and ceiling trim

1. Fit and install first piece of molding

a. Beginning in an inside corner, measure to determine length of molding

b. Cut ends square with miter saw or sawbuck

(NOTE: Use single pieces of molding as much as possible. Square cut each end if no splice is required. If a splice is required, miter the two pieces of molding to fit with the splice over a stud.)

c. Nail molding by placing a nail at each stud and then setting each nail

(NOTE: The size of the nail will depend on the type of molding being used.)

2. Fit and install remaining molding

a. Cope end of molding piece that will fit against first piece

(NOTE: The type of joint used may vary depending on the type of finish to be used, job requirements, or installer preference.)

b. Cut, fit, and nail remaining molding in place until installation is complete

B. Install vertical trim

1. Measure to determine required length

2. Cut each molding piece to length and miter or cope as required for desired fit

3. Nail in place with a nail near each end of each molding piece and at 12-inch intervals along each strip on alternating sides; set nails

C. Clean work area and put away tools and equipment

INTERIOR WALLS AND CEILINGS
UNIT III

JOB SHEET #2 — INSTALL PANEL WAINSCOT AND TRIM

I. Tools and equipment

A. Folding rule or steel tape

B. 30-inch or 3-foot level

C. Chalk line

D. Hammer

E. Scribe

F. Framing square

G. Nail sets

H. Paneling precut to 4′ × $31\frac{15}{16}$″

I. Cap molding

J. Base

K. 3d, 4d, and 6d finish nails

L. One pair of sawhorses

M. Power miter saw or saw buck and extension cord

N. Power jigsaw

II. Procedure for installing wainscot

(NOTE: Before starting application, be sure paneling has been stored in rooms at least twenty-four hours prior to installation.)

A. Stand paneling on end around room and arrange so that adjoining panels match as to grain patterns, color, and groove spacing

B. Establish line for top edge of panels

1. Measure up from floor $32\frac{1}{4}$ inches and mark wall at each corner and at edge of each opening (See Figure 12)

2. Snap a chalk line between each of these marks (See Figure 12)

(NOTE: It may be necessary to use a dry line to avoid staining finish material.)

JOB SHEET #2

C. Fit first panel at an inside corner

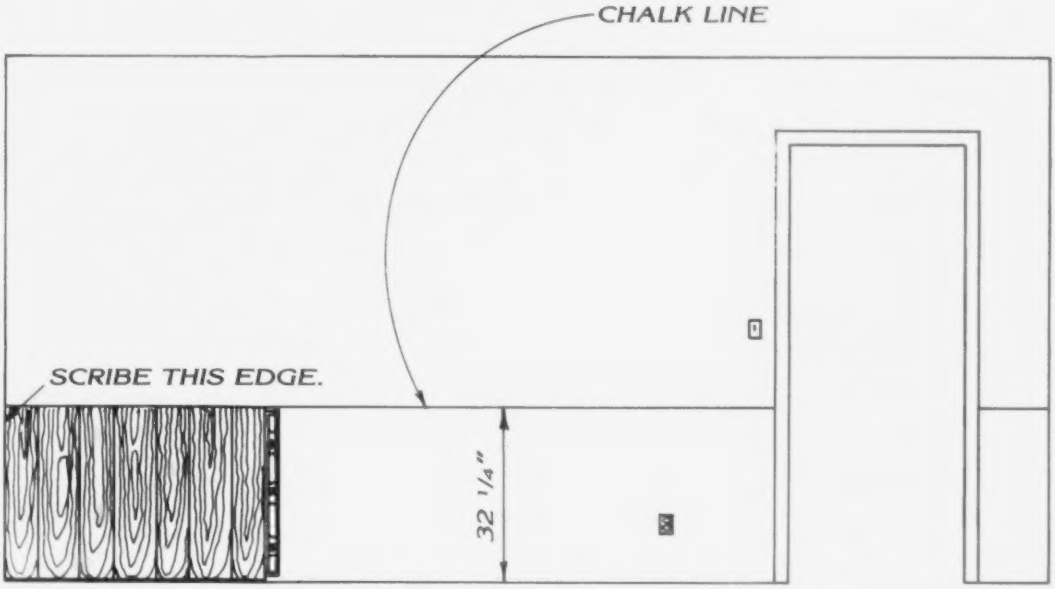
1. Position panel with top along chalk line, one edge at inside corner, and leading edge centered over a stud

   (NOTE: All joints must center over studs.)

2. Plumb leading edge of panel (See Figure 12)

3. Scribe edge of panel to fit inside corner (Figure 12)

FIGURE 12



4. Place panel on sawhorses and trim to scribed mark

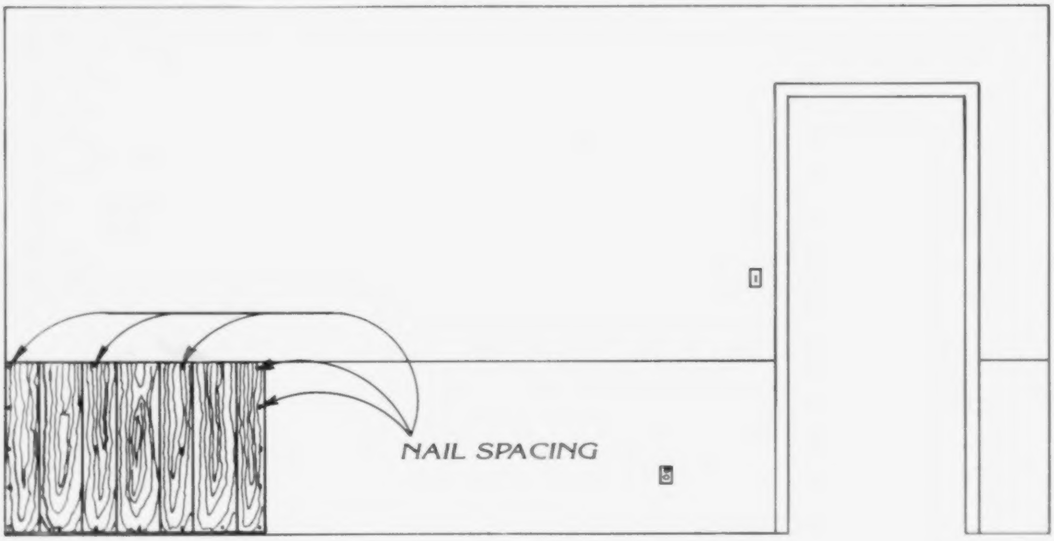
D. Install first panel

1. Set panel in position and check corner edge for accuracy and leading edge for plumb; make corrections as necessary

2. Nail edges of panel to studs, spacing 3d finish nails about 8 inches apart; nail at top, bottom, and center of panel on intermediate studs, concealing nails under trim whenever possible (See Figure 13)

JOB SHEET #2

FIGURE 13



E. Fit remaining panels

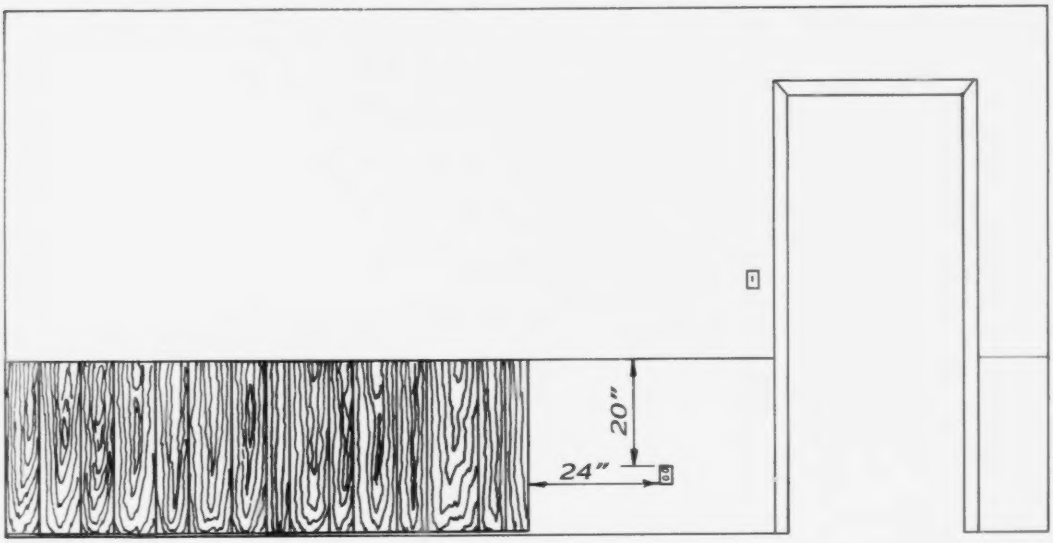
1. Align panels with sides of door and window openings whenever possible to conserve materials

2. Measure and lay out cutouts for switches and receptacles

   a. Measure for cutouts from mark on wall and from leading edge of panel already installed (See Figure 14)

JOB SHEET #2

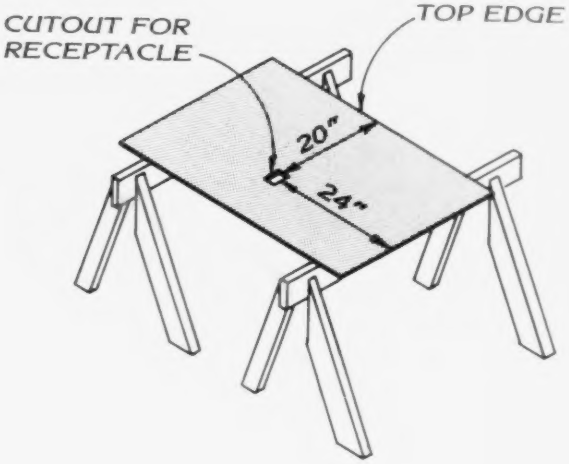
FIGURE 14



b. Transfer measurement to back side of panel (See Figure 15)

c. Use jig saw to cut out holes on back side of panel (Figure 15)

FIGURE 15


CUTOUT FOR RECEPTACLE
TOP EDGE
20"
24"

F. Install remaining panels following steps D-1 and D-2 for first panel

JOB SHEET #2

III. Procedure for installing trim

(NOTE: Similar procedures are used to install cap molding and baseboard.)

A. Fit and install first piece of molding

1. Beginning in a corner, measure to determine length of first piece of molding
2. Cut ends square with miter saw or sawbuck

   (NOTE: Use single pieces of molding as much as possible. Square-cut each end if no splice is required. If a splice is required, miter the two pieces of molding to fit with the splice over a stud.)

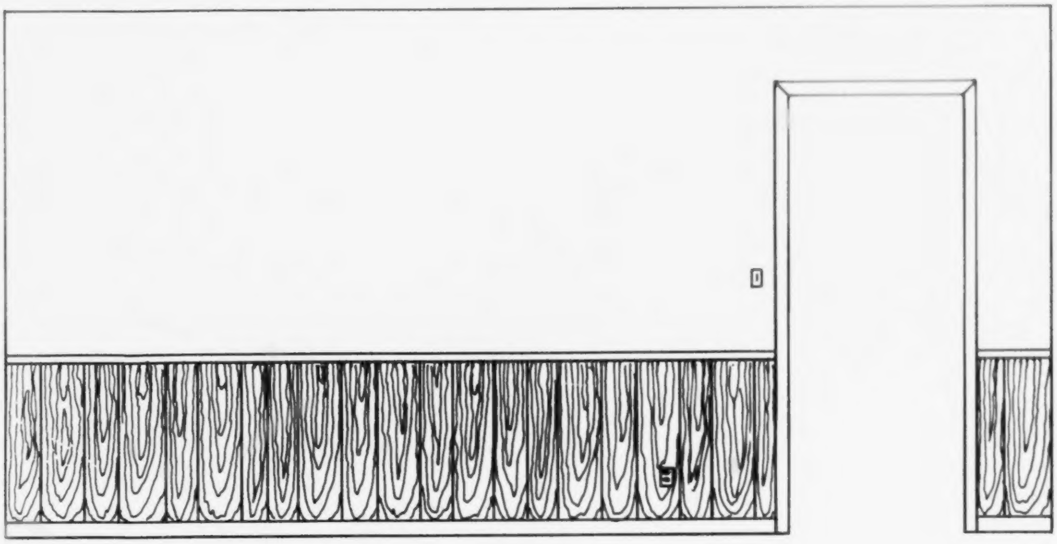
3. Nail molding in place, using 6d finish nails at each stud; set nails

B. Fit and install remaining molding

1. Cope end of molding piece that will fit in against first piece
2. Cut, fit, and nail remaining molding in place until installation is complete (Figure 16)

   (NOTE: Type of joints used [miter, coped, or square] depends on the type of finish required, job requirements, or installer preference.)

FIGURE 16



3. Set all nails in trim

C. Clean up area and put away tools and equipment

INTERIOR WALLS AND CEILINGS
UNIT III

JOB SHEET #3 — INSTALL FURRING STRIPS ON A MASONRY WALL

I. Tools and equipment

- A. Folding rule or steel tape
- B. Try square
- C. Hammer and masonry nails
- D. Power handsaw and extension cord
- E. Chalk line
- F. 1" × 2" furring strips
- G. Powder-actuated fastener, pins, and manufacturer's instruction booklet

II. Procedure

(NOTE: When all furring strips are installed and aligned, the wall is ready for paneling.)

- A. Install furring strip at floor line
    1. Measure and cut furring strip to fit horizontally on wall at floor line
    2. Nail furring strip in place, using powder-actuated fastener or hammer and masonry nails

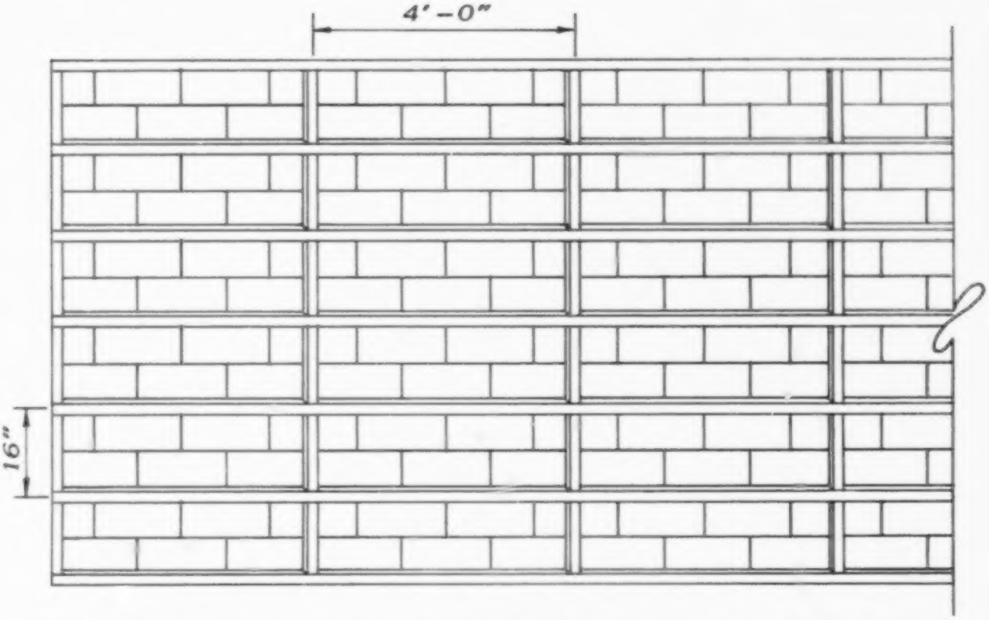
> **CAUTION**
>
> Do not use powder-actuated fastener until you have received your qualified operator's card. If you use fastener, enforce all safety rules and precautions.

- B. Lay out wall for horizontal furring strips spaced 16 inches on center starting from floor line (See Figure 17)
- C. Nail all horizontal furring strips in place
- D. Cut and nail vertical furring strips between horizontal strips in all corners and centered every 4 feet (See Figure 17)

(NOTE: The vertical strips are necessary to support the panel edges.)

JOB SHEET #3

FIGURE 17



E. Use a straightedge or string line to check alignment of furring strips; place shims behind furring strips if necessary

F. Clean area and put away all tools and equipment

INTERIOR WALLS AND CEILINGS

UNIT III

JOB SHEET #4 — INSTALL CEILING TILE OVER DRYWALL

I. Tools and equipment

   A. Folding rule or steel tape

   B. Chalk line

   C. Utility knife

   D. Straightedge

   E. Pointing trowel or caulking gun

   F. 12 × 12 ceiling tiles

   G. Adhesive

II. Procedure

   A. Mark center of each wall at ceiling

   B. Snap chalk line on ceiling between centers of two opposite walls

   C. Chalk another center line at right angle to first center line

   D. Starting at intersection of center lines and working out toward walls, begin installing tiles, keeping tiles aligned to center lines

   (NOTE: Some carpenters like to work from one side to the opposite side.)

      1. Use pointing trowel to place a small dab of adhesive on the bottom of each corner of each tile

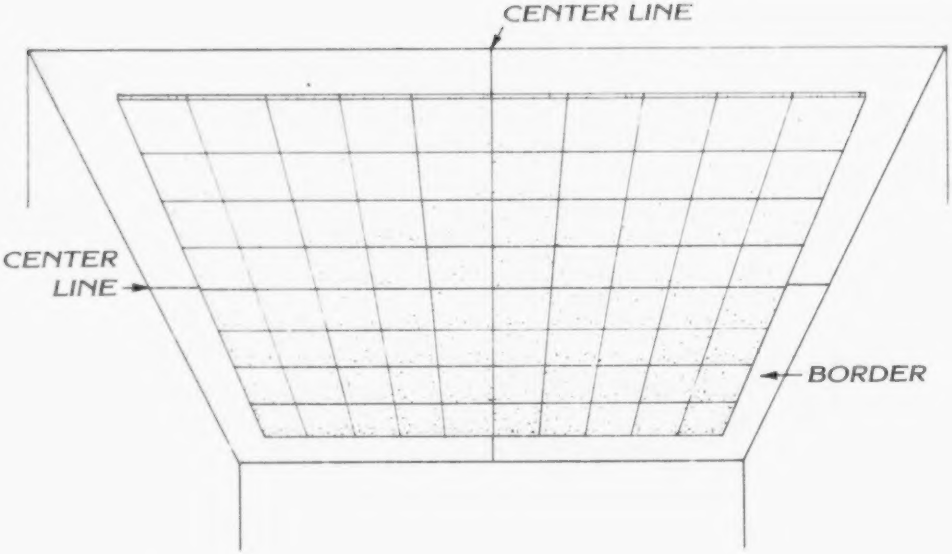
      2. Install each tile in position by pressing it to ceiling with a slight twist or sliding motion and then pulling back slightly and pushing it back into its proper position

      (NOTE: This procedure spreads the adhesive and ensures a good bond to the ceiling.)

   E. Continue installing tile until there is a border where there is not enough area to place a whole tile (See Figure 18)

JOB SHEET #4

FIGURE 18



F. Install border tiles

1. Measure and scribe each tile to fit border width
2. Use utility knife and straightedge to score face of tile to measured width
3. Break tile over a sharp edge
4. Apply adhesive, following steps D-1 and D-2

G. Clean up area and put away tools and equipment

INTERIOR WALLS AND CEILINGS
UNIT III

JOB SHEET #5 — INSTALL FURRING STRIPS ON CEILING JOISTS AND CEILING TILE ON FURRING

I. Tools and equipment

- A. Folding rule or steel tape
- B. Chalk line
- C. Try square
- D. Hammer
- E. Straightedge
- F. Utility knife
- G. Power staple gun, staples, and manufacturer's instructions
- H. Power handsaw and extension cord
- I. Jigsaw
- J. 1" × 4" furring strips
- K. Ceiling tile and manufacturer's instructions
- L. 8d common nails

II. Procedure

- A. Determine layout of furring strips
  1. Lay out furring strips at right angles to joists
  2. Measure width or length of room along joists
  3. Divide length of joist exposure by width of tile to determine width of border tiles

     (NOTE: The width of the border tile will be one-half the remainder found in step 3, but must be at least one-half the width of a tile.)

     EXAMPLE: If an installation is 17'-4" wide and uses 12" x 12" ceiling tile, the border would be 8 inches, or

     17'-4" ÷ 1'-0" = 17 with a remainder of 4"

     Since 4" ÷ 2 is less than one-half the width of one tile, add half the width of a tile, or

     2" + ½ (12") = 8" border.

JOB SHEET #5

B. Install furring strips

(NOTE: It may be necessary to install nailing blocks along sidewalls of installation if joists do not run along walls.)

1. Install first two furring strips perpendicular to joists along one wall so that second strip is centered along width of border tile
2. Use one nail in each joist and at the end of each strip
3. Cut furring strips so that splices are centered on joists
4. Install first and second furring strips on opposite wall, following procedure in step 1
5. Install remaining furring strips centered on intervals the width of full tiles

C. Lay out tile installation

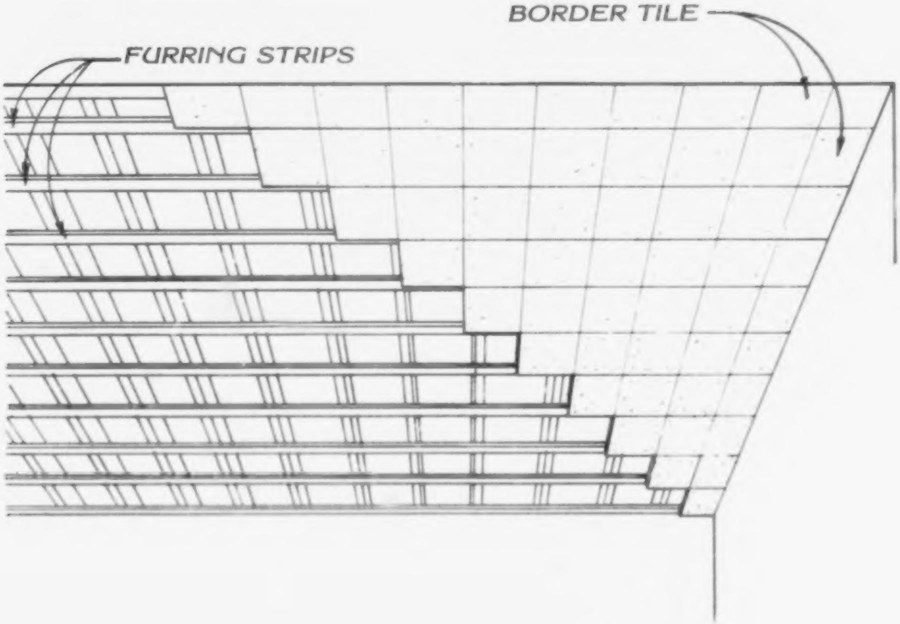
1. Determine width of border tiles along end walls, using procedure described in step A-3
2. Mark width of end border tile plus width of tile flange out from end wall at each end of furring strip
3. Snap a chalk line between marks
4. Mark width of side border tile plus width of flange out from sidewall
5. Snap a chalk line at this mark square to first chalk line

D. Install tile

1. Begin installation in corner at intersection of chalk lines
2. Cut first border tile to fit in corner with flanges aligned with chalk lines
3. Staple tile in place following manufacturer's recommendations regarding size, number, and placement of staples
4. Continue installing tiles using a stair-step pattern and frequently checking alignment (See Figure 19)

JOB SHEET #5

FIGURE 19


BORDER TILE
FURRING STRIPS

5. Measure and trim border tiles as required during installation

E. Clean up area and put away tools and equipment

INTERIOR WALLS AND CEILINGS
UNIT III

TEST

NAME ______________________ SCORE ____________

1. Match to their correct definitions terms associated with wall and ceiling finishes. Write the correct numbers in the blanks.

______a. Glue, cement, mastic, paste, or any substance capable of holding materials together by surface attachment

______b. Hardboard (usually with gypsum core) used to cover walls and ceilings

______c. Strips of wood or metal applied to surface to make it straight and plumb and to provide fastening surface for finish covering

______d. Mixture of lime, cement, and sand applied to walls and ceilings to finish their surfaces

______e. Thin sheet of hard, smooth, synthetic material that is highly resistant to scratching and wear; used for wainscoting and wall paneling

______f. Material used to fill holes in finished surface; is color-coded to match finished surface

______g. Tool with a sharp point used to make irregular marks for cutting and fitting a piece of material

______h. Material that covers lower part of an interior wall surface and contrasts with wall surface above

______i. Trim nailed to wall at top edge of wainscoting

______j. Metal, wood, or gypsum panel nailed to stud as backing or base for plaster

______k. To cut or shape the end of a piece of molding so that it will fit the contour of an adjoining piece of molding

1. Lath
2. Scribe
3. Adhesive
4. Putty stick
5. Wainscot
6. Drywall
7. Plastic laminate
8. Furring
9. Cope
10. Cap molding
11. Plaster

TEST

2. List materials used to finish walls and ceilings.

Walls (List four.)

a. ________________________________

b. ________________________________

c. ________________________________

d. ________________________________

Ceilings (List three.)

a. ________________________________

b. ________________________________

c. ________________________________

3. Name styles of paneling.

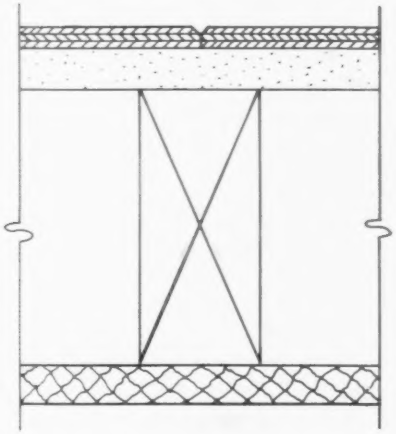
a. ________________________________

b. ________________________________

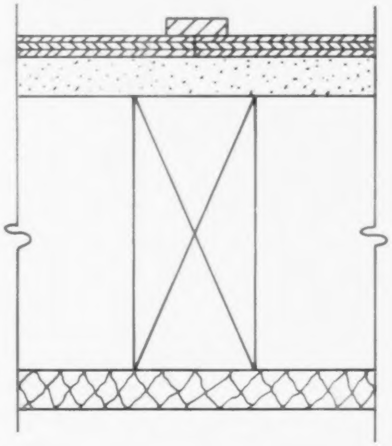
c. ________________________________

4. Identify the following illustrations of top views of joint treatments for paneling. Write the correct names in the blanks.

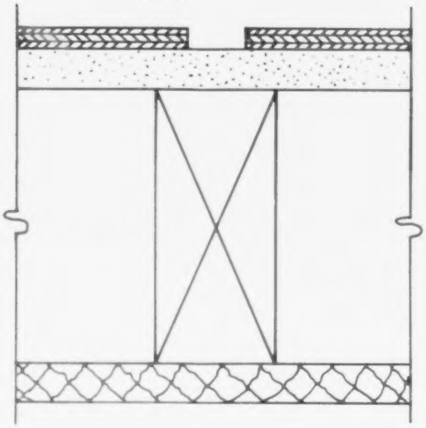
Batten strip **Open joint** **Butt joint with V-groove**



a. ________________________________



b. ________________________________



c. ______________________________

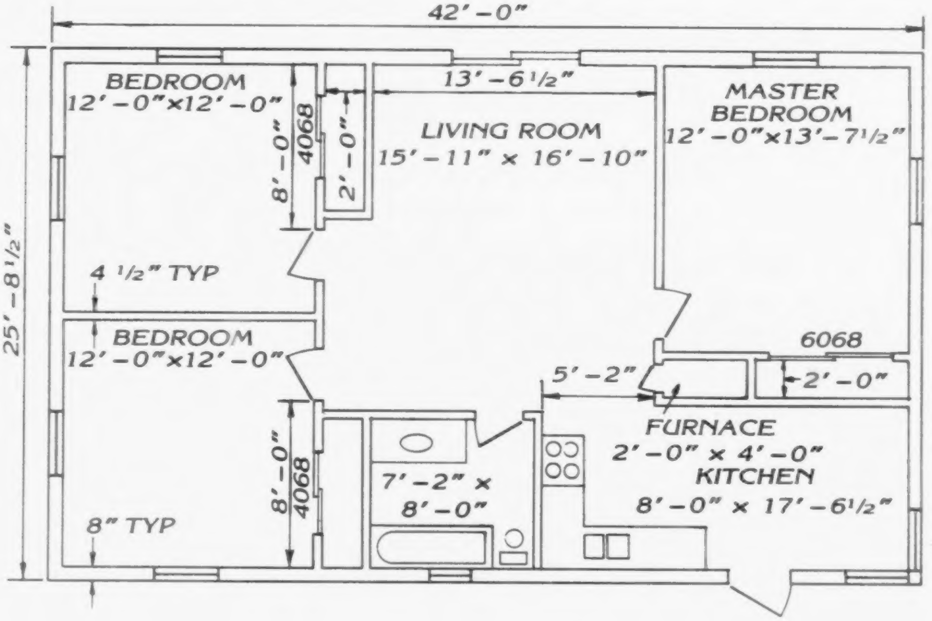
5. Estimate the number of 4′ × 8′ sheets needed to panel the living room and master bedroom (including closet) illustrated on the floor plan below. Write the correct answers in the blanks.

   a. Perimeter of living room = ______________________________

   b. Perimeter of master bedroom and closet = ______________________________

   c. Total lineal feet of wall = ______________________________

   d. Total number of 4′ × 8′ sheets needed = ______________________________


42′–0″
25′–8 1/2″
BEDROOM
12′–0″×12′–0″
8′–0″
4068
2′–0″
13′–6 1/2″
LIVING ROOM
15′–11″ × 16′–10″
MASTER
BEDROOM
12′–0″×13′–7 1/2″
4 1/2″ TYP
BEDROOM
12′–0″×12′–0″
6068
5′–2″
2′–0″
FURNACE
2′–0″ × 4′–0″
KITCHEN
8′–0″ × 17′–6 1/2″
8′–0″
4068
7′–2″ ×
8′–0″
8″ TYP

TEST

6. List three materials used to fabricate ceiling tile.

   a. ______________________________

   b. ______________________________

   c. ______________________________

7. List four factors that influence type of ceiling tile to be used.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

8. Estimate the number of ceiling tiles needed to finish ceilings with the dimensions given below. Each tile will cover one square foot. Write the correct answers in the blanks and show your work in the spaces provided.

   a. How many tiles will be needed for a room that is 16′-8″ × 20′-6″?

      Number of tiles = ______________________________

   b. How many tiles will be needed for a room that is 17′-6″ × 26′-0″?

      Number of tiles = ______________________________

TEST

c. How many tiles will be needed for a room that is 9'-10" × 19'-0"?

Number of tiles = ______________________________

(NOTE: Test question 9 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

9. Demonstrate the ability to

   a. Install V-grooved paneling and trim.

   b. Install panel wainscot and trim.

   c. Install furring strips on a masonry wall.

   d. Install ceiling tile over drywall.

   e. Install furring strips on ceiling joists and ceiling tile on furring.

INTERIOR WALLS AND CEILINGS
UNIT III

ANSWERS TO TEST

1. a. 3
   b. 6
   c. 8
   d. 11
   e. 7
   f. 4
   g. 2
   h. 5
   i. 10
   j. 1
   k. 9

2. **Walls** (Answer should include any four of the following.)

   a. Plaster
   b. Drywall
   c. Ceramic tile
   d. Solid-lumber paneling
   e. Plywood paneling
   f. Plastic laminate
   g. Hardboard paneling

   Ceilings (Answer should include any three of the following.)

   a. Plaster
   b. Drywall
   c. Drywall with exposed beams
   d. Ceiling tile
   e. Exposed roof-deck and beams

3. a. V-grooved
   b. Plain
   c. Brushed

4. a. Butt joint with V-groove
   b. Batten strip
   c. Open joint

5. (NOTE: Answers will vary due to methods of estimating.)

   a. 60′ – 4″
   b. 70′ – 7″
   c. 133′ – 11″ or 131 feet
   d. 33 sheets

6. Answer should include any three of the following

   a. Fiberboard
   b. Mineral
   c. Perforated metal
   d. Glass fiber
   e. Mirror

ANSWERS TO TEST

7. Answer should include any four of the following

   a. Appearance
   b. Initial cost
   c. Ease of installation
   d. Light reflection
   e. Fire resistance
   f. Sound absorption
   g. Maintenance cost
   h. Insulation value

8. (NOTE: Answers will vary due to methods of estimating.)

   a. 357
   b. 468
   c. 190

9. Performance skills evaluated to the satisfaction of the instructor

INTERIOR DOORS AND TRIM
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to discuss interior door installations and be able to install various types of door units, locks, and trim. The student will show this knowledge by completing the assignment sheets, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with interior doors and trim to their correct definitions.
2. State the general types of interior door construction.
3. State the basic classifications of interior doors.
4. Identify types of interior doors.
5. Identify parts of an interior door unit.
6. Select from a list standard sizes of interior doors and jambs.
7. Identify hand of a door.
8. Select from a list recommended finish clearances and dimensions for hanging doors.
9. Compute rough opening size for interior doors.
10. Identify hardware used with interior doors.
11. Identify types of interior trim.
12. Estimate material needed to trim a room.
13. Demonstrate the ability to
    a. Install interior door frame, hang door, lock, and trim.
    b. Install a split-jamb prehung door unit.
    c. Install a solid-jamb prehung door unit.
    d. Install a bifold door unit.
    e. Install a pocket door unit.
    f. Install window trim.

INTERIOR DOORS AND TRIM
UNIT IV

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Transparency Master #1 — Parts of a Door Unit

   D. Information sheet

   E. Assignment sheets

      1. Assignment Sheet #1 — Compute Rough Opening Size for Interior Doors

      2. Assignment Sheet #2 — Estimate Materials Needed to Trim a Room

   F. Answers to assignment sheets

   G. Job sheets

      1. Job Sheet #1 — Install Interior Door Frame, Hang Door, Lock, and Trim

      2. Job Sheet #2 — Install a Split-Jamb Prehung Door Unit

      3. Job Sheet #3 — Install a Solid-Jamb Prehung door Unit

      4. Job Sheet #4 — Install a Bifold Door Unit

      5. Job Sheet #5 — Install a Pocket Door Unit

      6. Job Sheet #6 — Install Window Trim

   H. Test

   I. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

   B. Obtain materials needed to supplement presentation.

      1. Transparencies

      2. Competency profiles

SUGGESTED ACTIVITIES

(NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

3. Sample materials and displays

4. Media and visual aids

(NOTE: A wall chart showing various types of molding is available from Southwest Moulding Company, 3950 LaReunion Parkway, Dallas, Texas 75212.)

C. Introduce unit.

SUGGESTIONS:

- Visit a construction site to view a house before and one after the trim work; point out how effective trim can be in improving appearance, hiding rough work, solving construction and design problems, creating effects, and other uses.

- Make a display of a door that can be adjusted to show what can happen if a door is improperly hung—such as out-of-square, misaligned, incorrectly sized, etc.

- Have the class discuss types of doors that they have seen, and use the discussion to introduce the concepts of classifications and types of doors designed for specific purposes.

- Invite a trim carpenter to talk to the class about that type of specialty; use a former student if possible.

D. Provide students with objective sheet.

E. Discuss unit and specific objectives, relating the objectives to each other, previous material, and your introduction to this unit.

F. Provide students with information sheet.

G. Discuss information sheet.

1. Use Information Sheet, Section I to discuss terms and definitions associated with interior doors and trim.

SUGGESTED ACTIVITIES

SUGGESTIONS:

- Have examples of materials and equipment.
- Use an actual door to explain appropriate terms.

2. Use Information Sheet, Section II, III, and IV to discuss interior doors, including construction, classification, and types.

   SUGGESTIONS:

   - Visit a plant that manufactures doors.
   - Invite a representative from a door manufacturer or distributor to discuss types of doors and their purposes.
   - Display solid-core and hollow-core doors that have been cut to show interior construction.
   - Relate each type of door to the three classifications; survey distributors to determine availability of the various types and the constructions that are available.
   - Discuss local building codes that regulate door use and construction.

3. Use Information Sheet, Section V and Transparency #1 or a full-size door to discuss parts of an interior door unit.

4. Use Information Sheet, Sections VI and VII to discuss hands of interior doors and standard sizes of interior doors and frames.

   SUGGESTIONS:

   - Invite a door manufacturer or distributor to talk to the class about door sizes and availability.
   - Discuss local building codes regulating door sizes.
   - Discuss methods of reducing door size, relating the amount of adjustment to door construction.
   - Provide the class with house plans and door schedules to discuss how door requirements are indicated; have students use plans or plans and schedules to write orders for the doors and jambs required.

5. Use Information Sheet, Sections VIII and IX to discuss interior door clearances and rough opening requirements.

SUGGESTED ACTIVITIES

SUGGESTIONS:

- Use a prehung door or model with adjustable jambs to demonstrate the need for proper clearances, including requirements for various floor coverings.
- Use Assignment Sheet #1 to allow students practice in computing rough openings.
- Demonstrate Job Sheets #2 and #3 and allow students to practice installing prehung door units.

6. Use Information Sheet, Section X to discuss hardware used with interior doors.

SUGGESTIONS:

- Provide the class with samples of each type of hardware.
- Explain the purpose of each type of hardware, being sure to clarify the differences among the types of locksets.
- Discuss local codes covering hardware requirements.
- Visit a construction site to view the installation of various types of hardware and completed homes to see the installed, operational hardware.

7. Use Information Sheet, Section XI to discuss types of interior trim.

SUGGESTIONS:

- Provide the class with samples of the various types of trim in a number of sizes, styles, and materials.
- Discuss applications and installation of trim, and visit sites to view trim applications.
- Make flashcards of the various types and styles of trim; use the cards to help class learn to identify the trim materials.

8. Use Information Sheet, Section XII to discuss estimating interior door and trim materials.

SUGGESTIONS:

- Have a materials supplier discuss ordering procedures and the availability of door and trim materials used in your area.

SUGGESTED ACTIVITIES

- Use Assignment Sheet #2 to allow students practice in estimating materials.
- Provide students with floor plans and schedules, and have them write orders for doors and trim.
- Demonstrate remaining job sheet procedures and allow students to practice skills.

H. Review unit.

I. Give test.

J. Critique test and review in class.

K. Reteach and retest as required.

L. Complete appropriate sections of competency profiles.

III. Unit references

A. *General Catalog.* Tulsa, Oklahoma: Gates Hardware and Supply Company.

B. Hendrix, Laborn J. "Bud." *Commercial Carpentry.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1979.

C. Hepler, Donald E., and Paul I. Wallach. *Architecture: Drafting and Design*, 3rd ed. New York: McGraw-Hill, 1977.

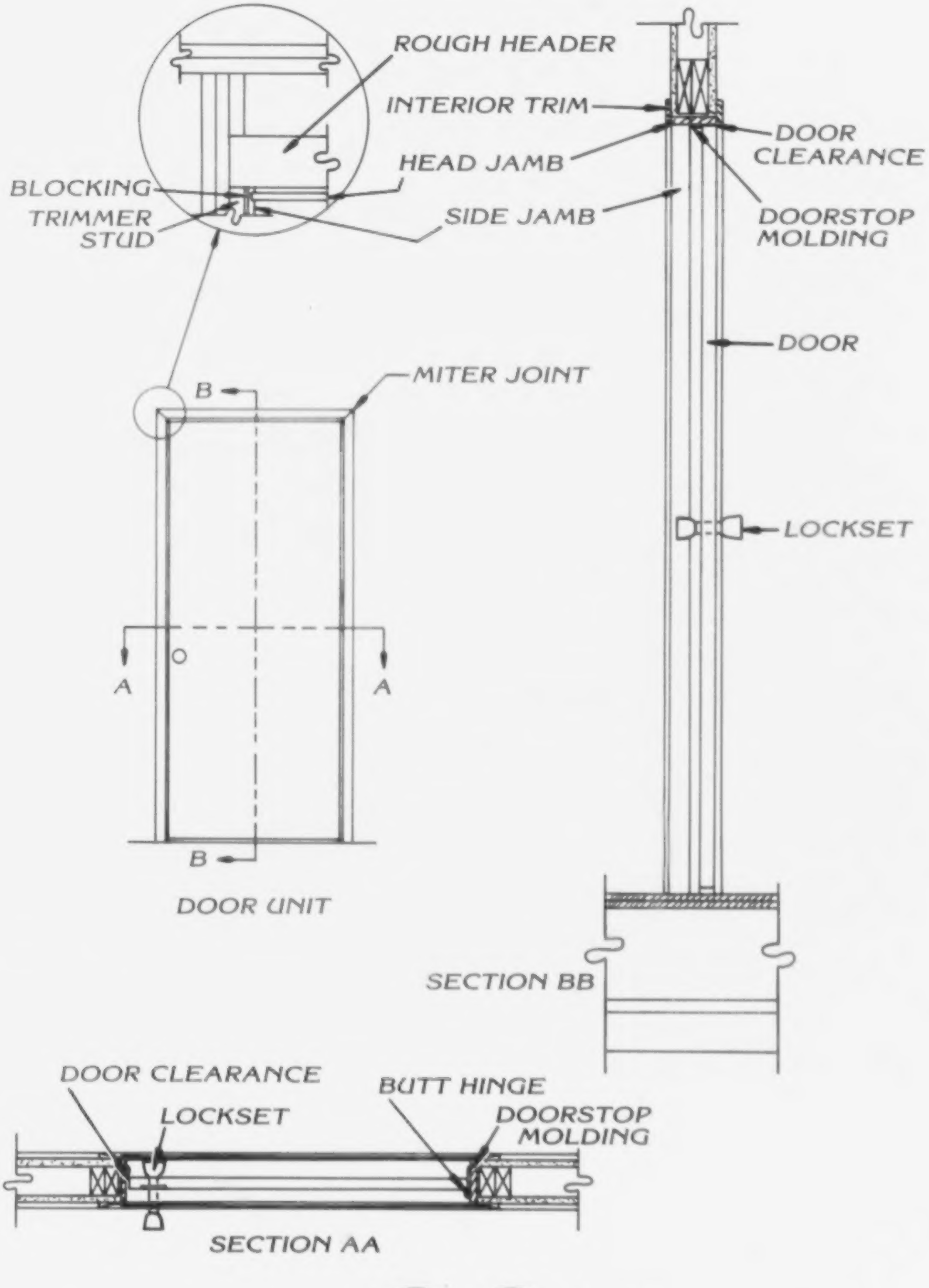
D. *Paxton Beautiful Woods.* Oklahoma City, Oklahoma: Frank Paxton Lumber Company, 1983.

E. Ramsey, Charles G., and Harold R. Sleeper. *Architectural Graphic Standards*, 6th ed. Edited by Joseph N. Boaz. New York: John Wiley and Sons, Inc., 1970.

F. "Moulding Chart," Dallas, Texas: Southwest Moulding Company.

G. Wagner, Willis. *Modern Carpentry.* South Holland, Illinois: Goodheart-Willcox Co., Inc., 1976.

Parts of a Door Unit


ROUGH HEADER
INTERIOR TRIM
DOOR CLEARANCE
HEAD JAMB
BLOCKING
TRIMMER STUD
SIDE JAMB
DOORSTOP MOLDING
DOOR
MITER JOINT
B
B
A
A
LOCKSET
DOOR UNIT
SECTION BB
DOOR CLEARANCE
BUTT HINGE
LOCKSET
DOORSTOP MOLDING
SECTION AA

1015

INTERIOR DOORS AND TRIM
UNIT IV

INFORMATION SHEET

I. Terms and definitions

A. Door frame — Assembly of wood parts that form an enclosure and support for a door

B. Clearance — Spacing between edge of door and jamb, and between jamb and trimmer stud

C. Reveal — Space or setback between casing or trim and the edge of door or window frame; usually $\frac{3}{16}$ to $\frac{3}{8}$ inch

D. Miter joint — Joint between two pieces of material at an angle that bisects the angle of junction

E. Jig — Device used to guide tools or materials when performing a particular job

F. Template — Gauge or pattern used as a guide to form or shape pieces being made

G. Doorstop or bumper — Small post with rubber tip, installed to limit the swing of a door in order to protect door, wall, or another door

(NOTE: The term *doorstop* also refers to the molding strip on a door frame that keeps the door from swinging through.)

H. Cope — To cut or shape the end of a piece of molding so that it fits the contour of an adjoining piece of molding

I. Casing — Framework of trim of various widths and thicknesses used around windows and doors

J. Base — Finish molding covering bottom edge of wall material where the wall and floor meet

K. Astragal — Molding or trim attached to inside edge of one of a pair of doors or windows to prevent swinging through; also used with sliding doors to ensure tighter fit where doors meet

L. Apron — Horizontal trim immediately under a window stool

M. Batten — Narrow strips of wood or metal trim used to cover joints of sheathing or other materials to seal the joints

N. Doorstop molding — Molding nailed to the faces of a door frame to prevent door from swinging through

O. Cap molding — Molding nailed to the wall at top edge of wainscot panel

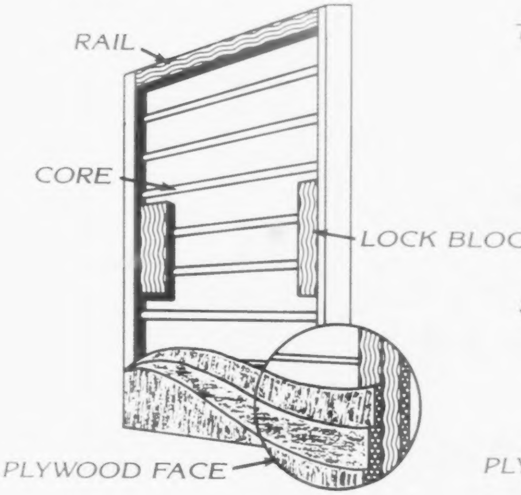
INFORMATION SHEET

II. General types of interior door construction (Figures 1 and 2)

A. Hollow core

EXAMPLE:

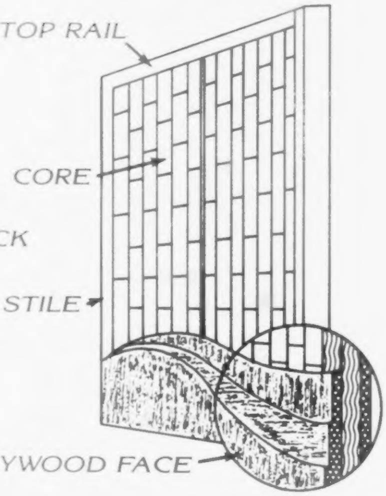
FIGURE 1


RAIL
CORE
LOCK BLOCK
PLYWOOD FACE

B. Solid core

EXAMPLE:

FIGURE 2


TOP RAIL
CORE
STILE
PLYWOOD FACE

III. Basic classifications of interior doors

A. Swinging

B. Sliding

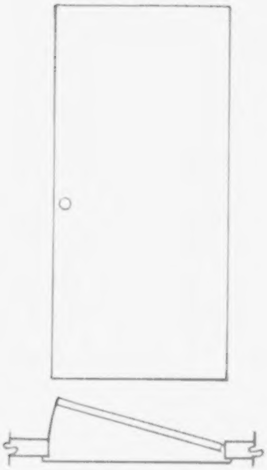
C. Folding

INFORMATION SHEET

IV. Types of interior doors (Figures 3-12)

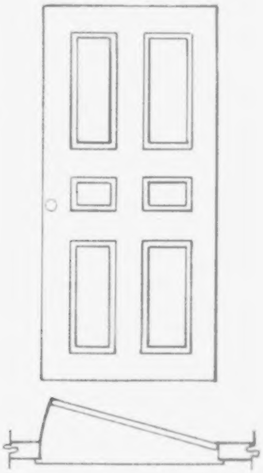
A. Flush

FIGURE 3



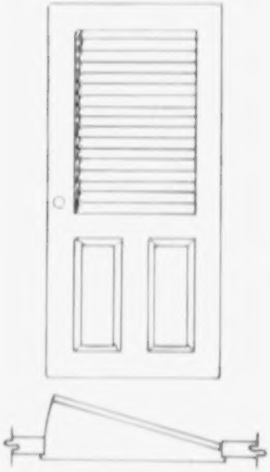
B. Panel

FIGURE 4



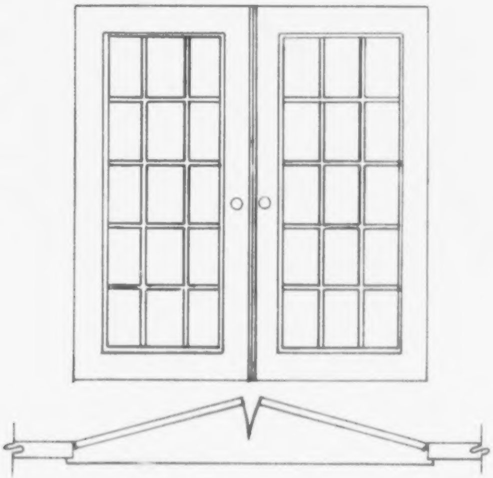
C. Louver

FIGURE 5



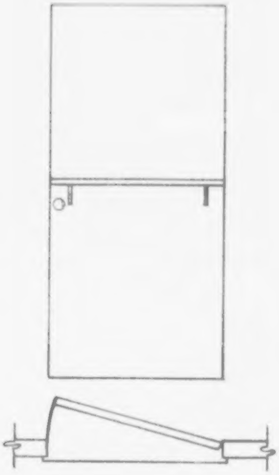
D. French

FIGURE 6



E. Dutch

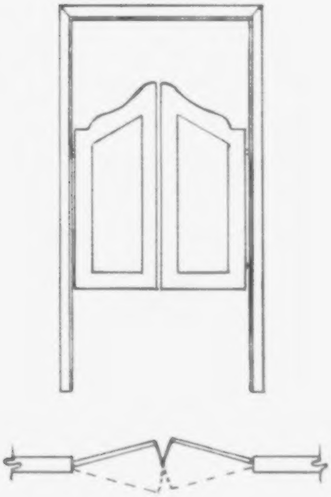
FIGURE 7



INFORMATION SHEET

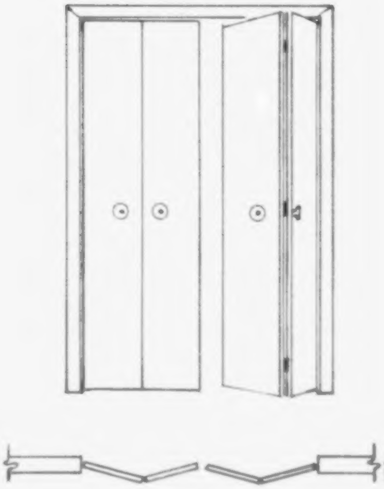
F. Cafe

FIGURE 8



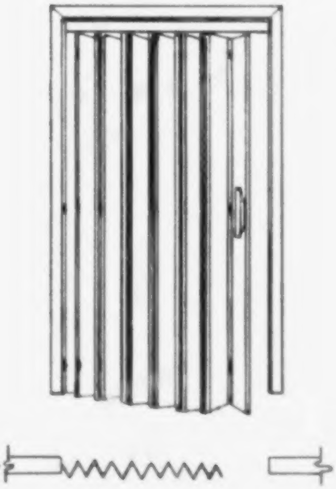
G. Bifold

FIGURE 9



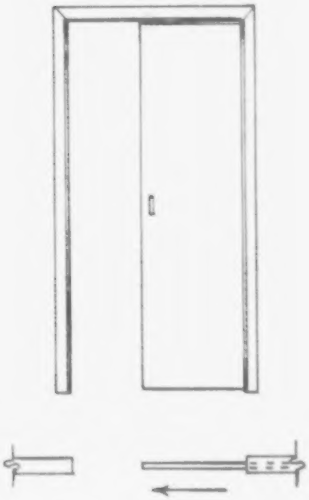
H. Multifold or accordian

FIGURE 10



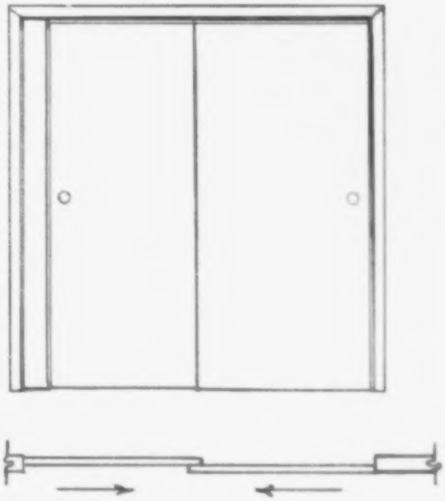
I. Sliding pocket

FIGURE 11



J. Bipass sliding

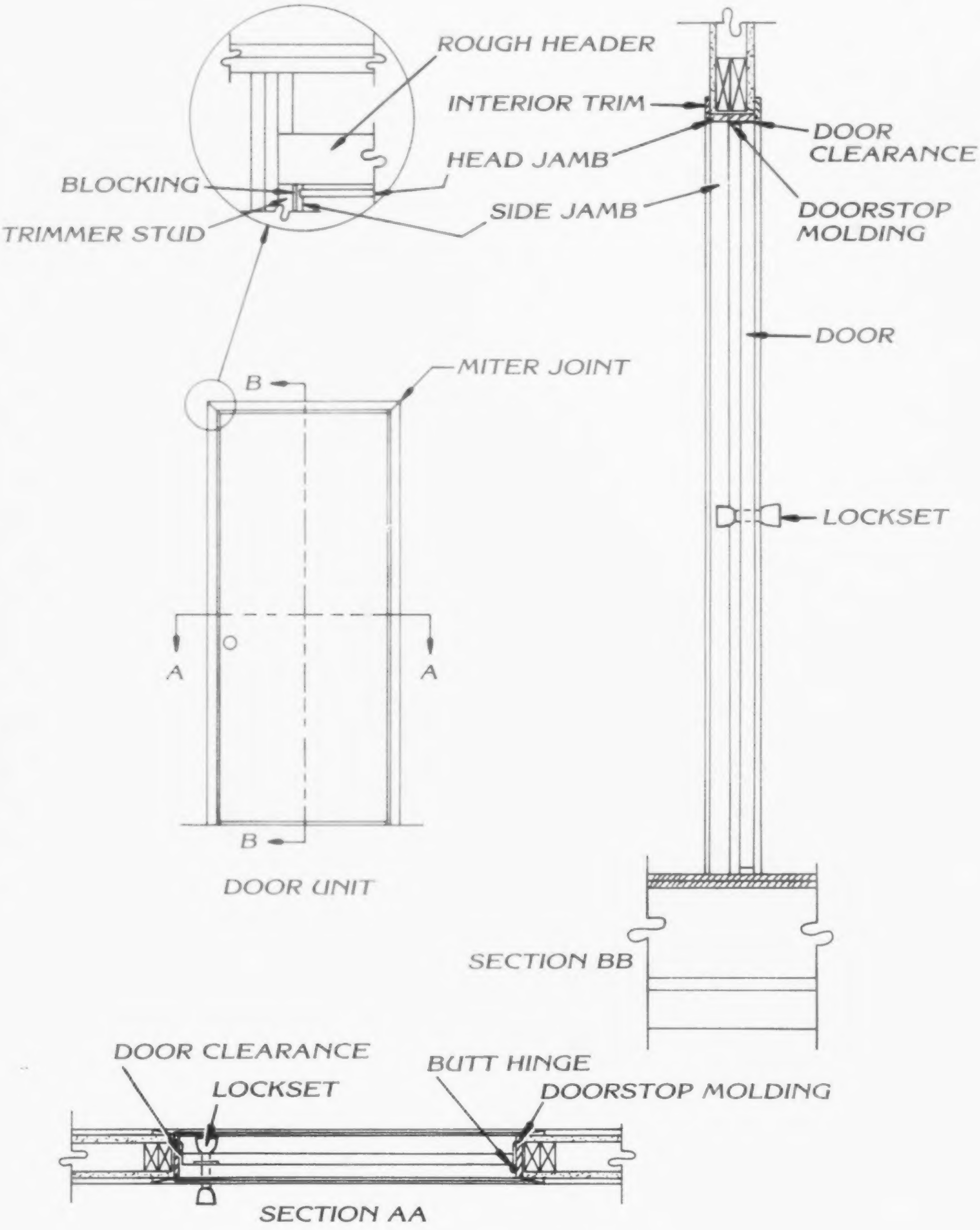
FIGURE 12



INFORMATION SHEET

V. Parts of an interior door unit (Figure 13)

FIGURE 13


ROUGH HEADER
INTERIOR TRIM
DOOR CLEARANCE
HEAD JAMB
BLOCKING
SIDE JAMB
DOORSTOP MOLDING
TRIMMER STUD
DOOR
MITER JOINT
B
B
LOCKSET
A
A
DOOR UNIT
SECTION BB
DOOR CLEARANCE
BUTT HINGE
LOCKSET
DOORSTOP MOLDING
SECTION AA

INFORMATION SHEET

VI. Standard sizes of interior doors and jambs (Table 1)

(NOTE: Door sizes are normally given as width by height by thickness. The notation for a door that is 2 feet, 4 inches wide and standard height and thickness may be written 2′ –4″ × 6′ –8″, or 2/4 × 6/8, or 2468. The thickness is often not listed, and occasionally the height is not given for standard dimensions.)

TABLE 1 Standard Sizes of Interior Doors and Frames

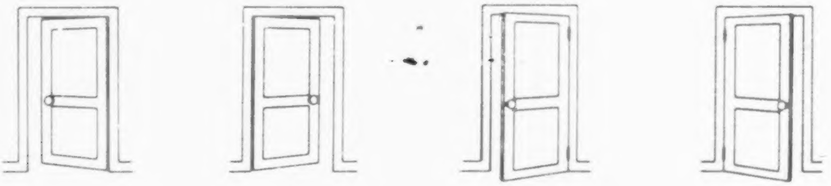
	Width	Height	Thickness
Swinging door	2′ –0″ 2′ –4″ 2′ –6″ 2′ –8″ 3′ –0″	6′ –8″	1$^3/_8$″
Folding door	2′ –0″ 2′ –4″ 2′ –6″ 2′ –8″ 3′ –0″ 3′ –6″ 4′ –0″	6′ –8″ 7′ – 10″	1″ 1$^1/_4$″ 1$^3/_8$″
Sliding door	2′ –0″ 2′ –4″ 2′ –6″ 2′ –8″ 3′ –0″ 3′ –6″ 4′ –0″	6′ –8″	1$^3/_8$″
Jambs	2′ –0″ 2′ –4″ 2′ –6″ 2′ –8″ 3′ –0″	6′ –8″	4$^5/_8$″
Casing and doorstops	Precut to jamb size or in random lengths of odd and even feet to be cut on the job		

INFORMATION SHEET

VII. Hand of a door (Figure 14)

(NOTE: *Hand* or *swing* of a door refers to which direction a door opens as viewed by someone standing outside the room and facing the door.)

FIGURE 14



RIGHT HAND *LEFT HAND* *RIGHT HAND REVERSE* *LEFT HAND REVERSE*

A. Right hand (RH)

   1. Hinges are on the right
   2. Door swings away from you

B. Left hand (LH)

   1. Hinges are on the left
   2. Door swings away from you

C. Right hand reverse (RHR)

   1. Hinges are on the right
   2. Door swings toward you

D. Left hand reverse (LHR)

   1. Hinges are to your left
   2. Door swings toward you

VIII. Recommended finish clearances and dimensions for hanging doors

A. Clearance

   1. Top of door—$\frac{3}{32}$ inch
   2. Sides of door—$\frac{3}{32}$ inch each
   3. Bottom of door—$\frac{5}{8}$ inch

      (NOTE: Where door swings across carpet, clearance may need to be increased.)

INFORMATION SHEET

B. Dimensions

1. Top hinge—7 inches down from top of door
2. Bottom hinge—11 inches up from bottom of door
3. Center hinge—centered between other two hinges
4. Doorknob—36 inches from floor

IX. Computing rough opening size for interior doors

(NOTE: The procedure below gives the method for computing exact openings. Most carpenters will add 2 1/2 inches to the door width and 2 inches to door height to determine working opening size.)

A. Width

1. Check door schedule for door size
2. Add 3/16 inch (3/32 inch each side) to door for clearance between door and side jambs
3. Add 1 1/4 inches (5/8 inch each side) for side jambs
4. Add 1 inch (1/2 inch each side) for clearance between jamb and trimmer stud

EXAMPLE: 2′-6″ × 6′-8″ door

Door width	2′-6″
Door and jamb clearance	3/16″
Side jambs	1 1/4″
Side jamb and trimmer clearance	+ 1″
Exact opening width	2′-8 7/16″
Rough opening width	2′-8 1/2″

B. Height

1. Check door schedule for door size
2. Add 3/32 inch to door height for clearance between door and header jamb
3. Add 5/8 inch for header jamb
4. Add 1/2 inch for header jamb and rough header clearance
5. Add 5/8 inch for clearance under door

INFORMATION SHEET

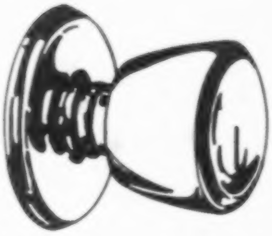
EXAMPLE:	2′ – 6″ × 6′ – 8″ door	
	Door height	6′ – 8″
	Door and header clearance	3/32″
	Header jamb	5/8″
	Header jamb and rough header clearance	1/2″
	Bottom clearance	+ 5/8″
	Exact opening height	6′ – 9 27/32″
	Rough opening height	6′ – 10″

X. Hardware used with interior doors (Figures 15-27)

A. Locksets

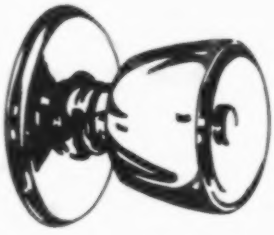
1. Passage

FIGURE 15



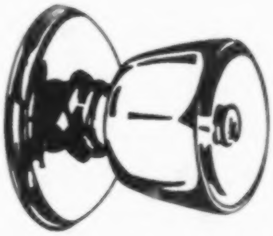
2. Privacy

FIGURE 16



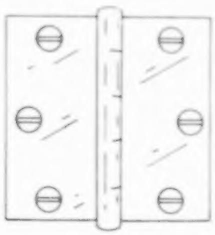
3. Keyed

FIGURE 17



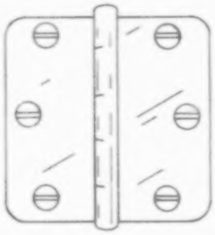
B. Butt hinges

FIGURE 18



FULL MORTISE WITH SQUARE CORNERS

FIGURE 19

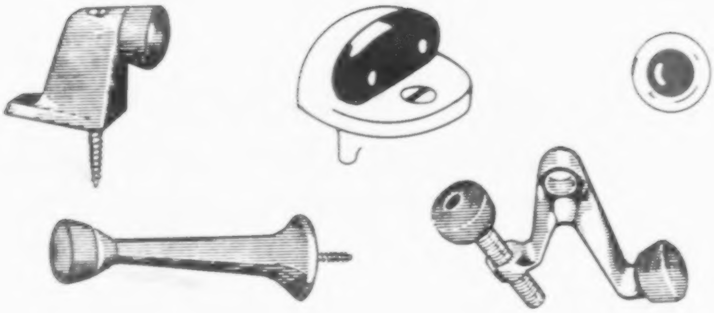


FULL MORTISE WITH RADIUS CORNERS

INFORMATION SHEET

C. Doorstops

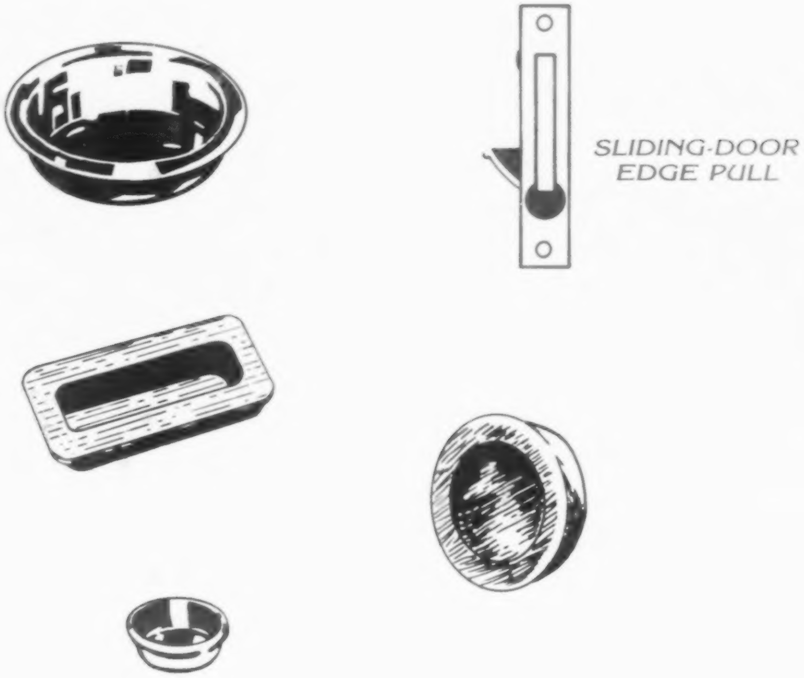
FIGURE 20



D. Recessed door pulls

(NOTE: Door pulls and doorknobs may be wooden or metal.)

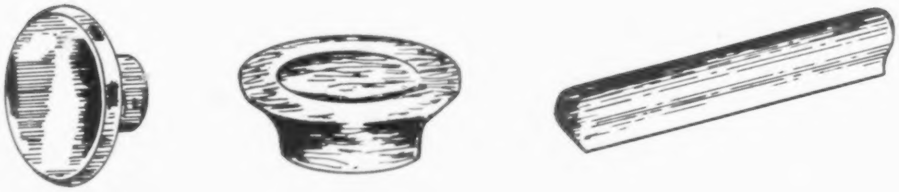
FIGURE 21


SLIDING-DOOR
EDGE PULL

INFORMATION SHEET

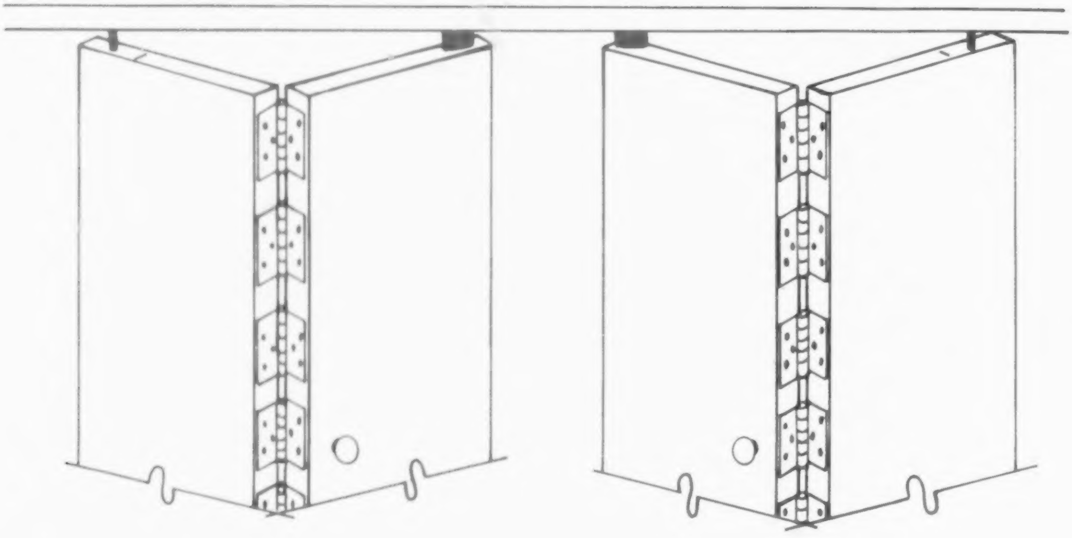
E. Doorknobs and pulls

FIGURE 22



F. Bifold-door hardware

FIGURE 23



INFORMATION SHEET

G. Pocket-door hardware

FIGURE 24

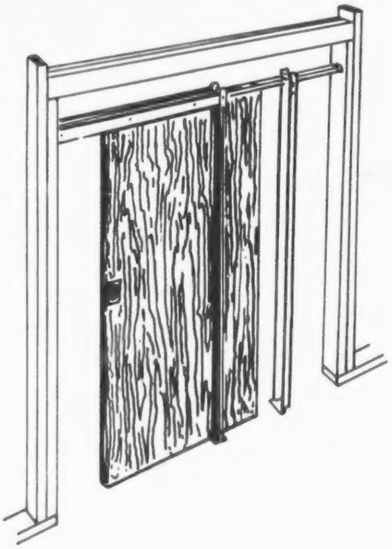
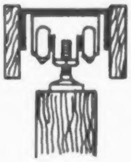


FIGURE 25



H. Sliding-door hardware

FIGURE 26

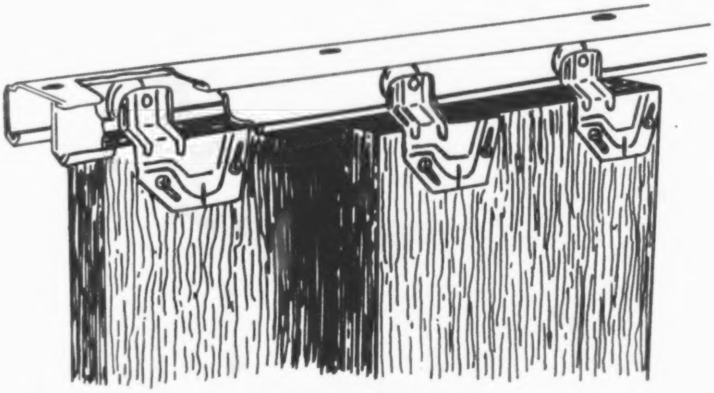
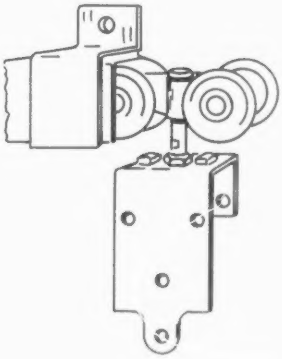


FIGURE 27



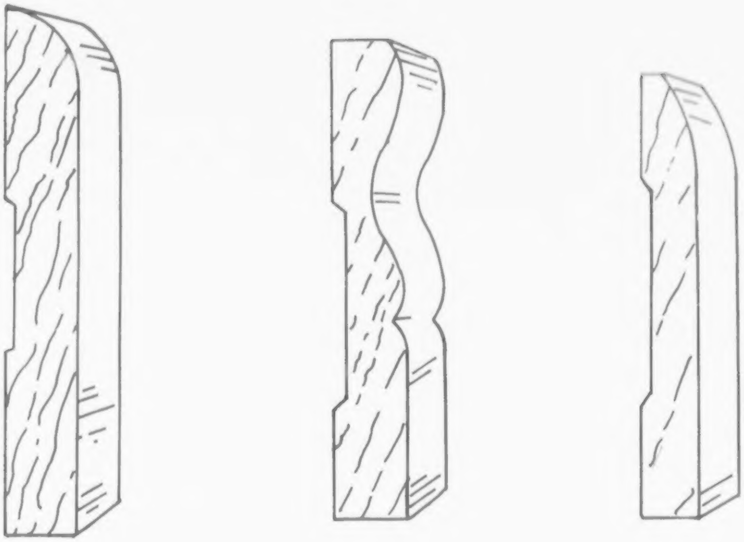
XI. Types of interior trim (See Figures 28-41)

(NOTE: Examples of mold styles include colonial, sanitary, step, k, and h.)

INFORMATION SHEET

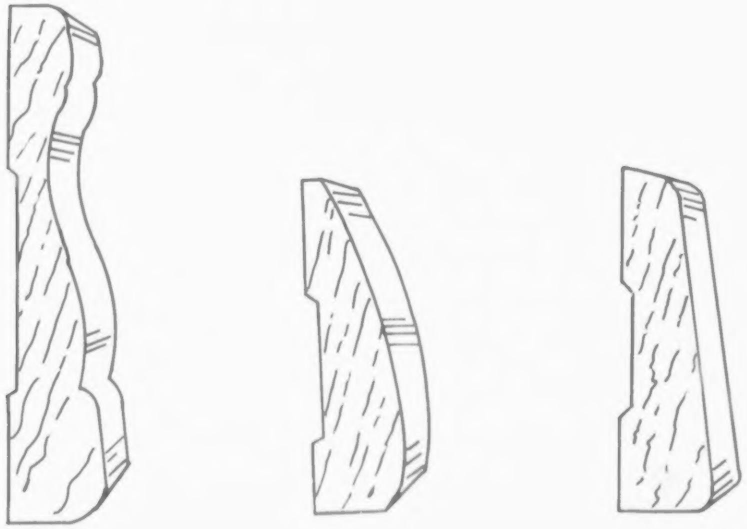
A. Base

FIGURE 28



B. Casing

FIGURE 29

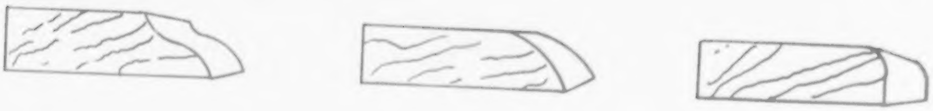


Figures 28 and 29 used with permission of Southwest Moulding Company, Dallas, Texas.

INFORMATION SHEET

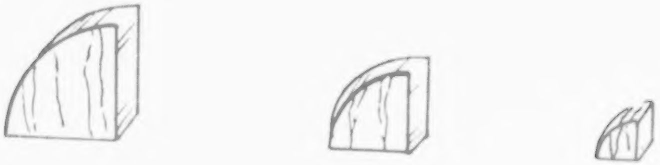
C. Doorstop molding

FIGURE 30



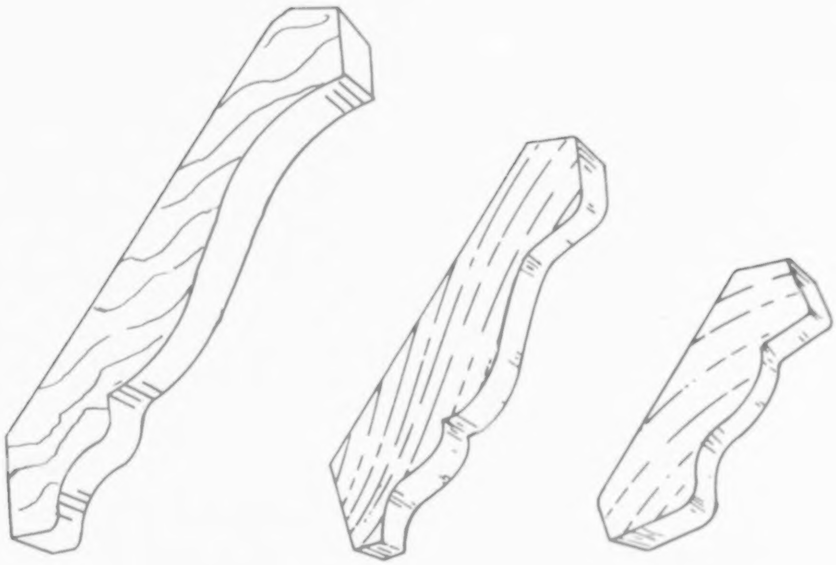
D. Quarter round

FIGURE 31



E. Crown

FIGURE 32

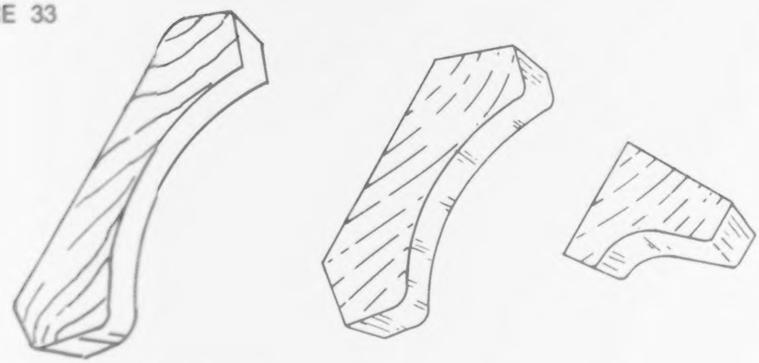


Figures 30-32 used with permission of Southwest Moulding Company, Dallas, Texas.

INFORMATION SHEET

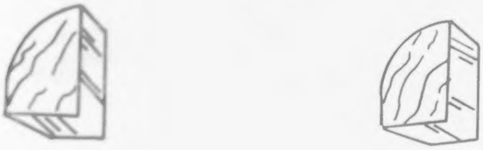
F. Cove

FIGURE 33



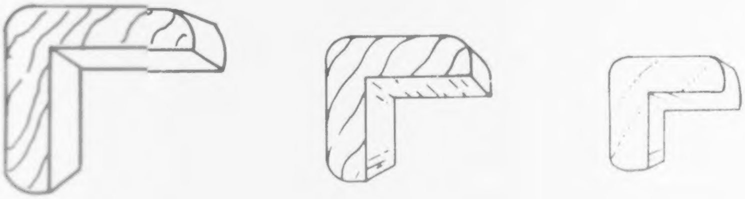
G. Shoe molding (base shoe)

FIGURE 34



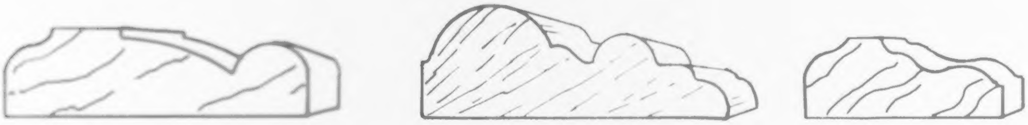
H. Outside corner

FIGURE 35



I. Chair rail

FIGURE 36

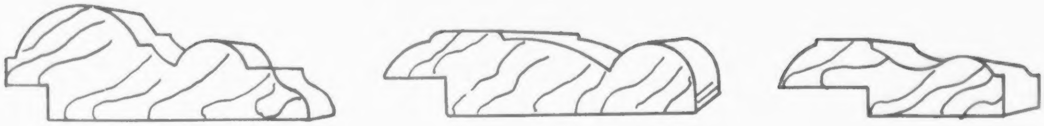


Figures 33-36 used with permission of Southwest Moulding Company, Dallas, Texas.

INFORMATION SHEET

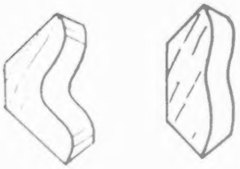
J. Cap molding (cap strip)

FIGURE 37



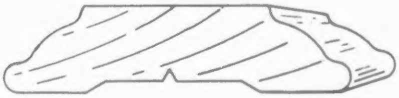
K. Inside corner

FIGURE 38



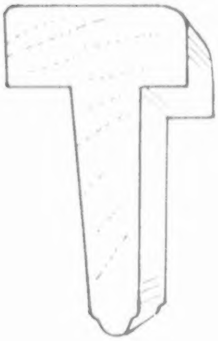
L. Batten

FIGURE 39



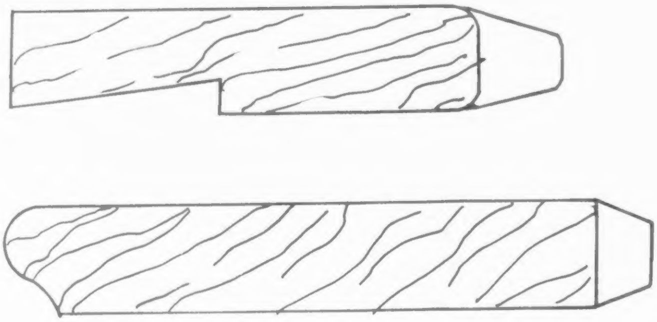
M. T-astragal

FIGURE 40



N. Window stool

FIGURE 41



Figures 37-41 used with permission of Southwest Moulding Company, Dallas, Texas.

INFORMATION SHEET

XII. Material estimating (Figure 42)

A. Door units and hardware — Determine numbers, sizes, styles, and specifications from plans and schedules

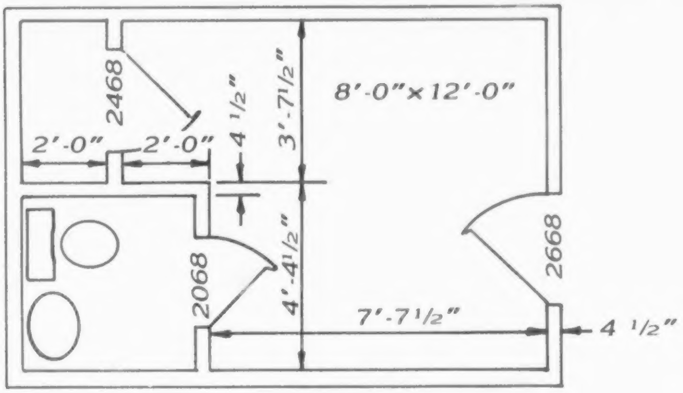
(NOTE: When ordering doors, jamb sets, casing material, doorstops, hinges, locksets, and specialty hardware, specify how many of each item are required and other requirements such as those listed in the examples below.)

B. Trim — Determine number of lineal feet required from plans, and order each type of trim to the next highest even lineal foot

(NOTE: Schedules and specifications generally list doors and trim requirements. The listing in the example below is not intended to represent details or specifications but is meant only to show an example of material that might be used for the plan shown.)

EXAMPLE:

FIGURE 42



1. Doors
   a. One 2/0 × 6/8 × 1 3/8 hollow core, mahogany
   b. One 2/4 × 6/9 × 1 3/8 hollow core, mahogany
   c. One 2/6 × 6/8 × 1 3/8 hollow core, mahogany
2. Jambs
   a. One 2/0 interior jamb
   b. One 2/4 interior jamb
   c. One 2/6 interior jamb
3. Casing and doorstops
   a. Two sets 2/0 colonial casing
   b. Two sets 2/4 colonial casing
   c. Two sets 2/6 colonial casing
   d. One set 2/0 × 7/16 × 1 3/8 O.G. doorstop
   e. One set 2/4 × 7/16 × 1 3/8 O.G. doorstop
   f. One set 2/6 × 7/16 × 1 3/8 O.G. doorstop
4. Butt hinges — five pairs 3 1/2 inches square butt hinges
5. Locksets
   a. Two Best Lock Co. Style 300, antique brass, privacy lockset
   b. One Best Lock Co. Style 300, antique brass, passage lockset
6. Trim
   a. 58 lineal feet 1/2 inch × 3 inch colonial base
   b. 58 lineal feet 1/2 inch × 3/4 inch shoe molding
   c. 8 lineal feet 1 inch × 1 inch outside corner

INTERIOR DOORS AND TRIM
UNIT IV

ASSIGNMENT SHEET #1 — COMPUTE ROUGH OPENING SIZE FOR INTERIOR DOORS

NAME ______________________________ SCORE ______________

Door units and trim are generally expensive items due to the millwork involved. Additionally, the interior trim phase of construction greatly impacts on other phases of construction and must be carefully scheduled. For these reasons, delays due to incorrect material or inadequate preparation must be avoided. This assignment will help you become better at calculating rough opening sizes so that framing for door openings can be done properly and inspected when it comes time to hang the door.

Compute actual rough opening size for the following door sizes.

A. 2′-0″ × 6′-8″

1. Width — ____________

2. Height — ____________

B. 3′-0″ × 7′-0″

1. Width — ____________

2. Height — ____________

C. 2′-8″ × 6′-8″

1. Width — ____________

2. Height — ____________

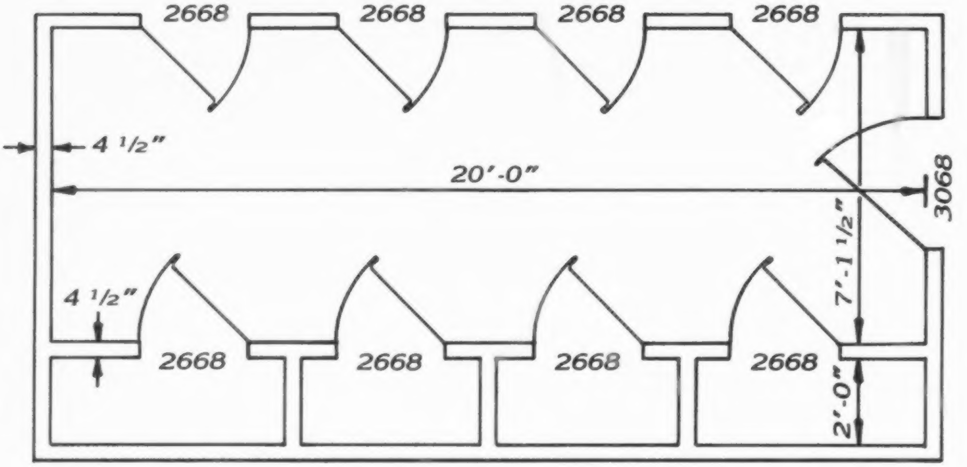
INTERIOR DOORS AND TRIM
UNIT IV

ASSIGNMENT SHEET #2 — ESTIMATE MATERIALS NEEDED TO TRIM A ROOM

NAME ______________________________ SCORE ______________

The competent carpenter knows how to estimate materials quickly and accurately for a specific job. Accurate estimation is cost effective and eliminates needless waste of materials and time. This exercise is meant to help you become a competent estimator.

Estimate the amount of material needed to trim the room illustrated. Write your answers on the next page.



Use 7/16" × 3" san base, 5/8" × 2 1/4" san casing, 7/16" × 3/4" shoe molding. Use two 3 1/2" butt hinges on interior doors and three on exterior doors. Use streamline Kwikset locksets on each flush-type door. One lockset is privacy; others are passage. San doorstops are 3/8" × 1 3/8". Use WP84, 9/16" × 2 1/4" cove molding in large room only.

ASSIGNMENT SHEET #2

A. Doors

1. Type — ______________________________

2. Size — ______________________________

3. Number — ______________________________

B. Jamb sets

1. Size — ______________________________

2. Number — ______________________________

C. Casing and doorstop sets

1. Type and size — ______________________________

2. Number of sets — ______________________________

D. Butt hinges (pairs)

1. Size — ______________________________

2. Number — ______________________________

E. Locksets

1. Type — ______________________________

2. Style — ______________________________

3. Brand — ______________________________

4. Number of each — ______________________________

F. Other trim (lineal feet)

1. Base — ______________________________

2. Shoe molding — ______________________________

3. Cove molding — ______________________________

INTERIOR DOORS AND TRIM
UNIT IV

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

(NOTE: Answers are given first for the exact method and then for the shortcut method.)

A. 1. Width — 2′ – 2 7/16″ or 2′ – 2 1/2″

2. Height — 6′ – 9 27/32″ or 6′ – 10″

B. 1. Width — 3′ – 2 7/16″ or 3′ – 2 1/2″

2. Height — 7′ – 1 27/32″ or 7′ – 2″

C. 1. Width — 2′ – 10 7/16″ or 2′ – 10 1/2″

2. Height — 6′ – 9 27/32″ or 6′ – 10″

Assignment Sheet #2

(NOTE: Because estimating answers will vary considerably, answers should be evaluated to the satisfaction of the instructor.)

A. Doors

1. Type — Flush

2. Size — 2/6 × 6/8 and 3/0 × 6/8

3. Number — Eight 2/6 × 6/8; one 3/0 × 6/8

B. Jambs

1. Size — 5/8″ × 4 5/8″

5/8″ × 4 5/8″

2. Number — Eight 2/6 × 6/8 interior jambs, one 3/0 × 6/8 exterior jamb

C. Casing and doorstop sets

1. Type and size — San casing 5/8″ × 2 1/4″ each door size

San doorstops 3/8″ × 1 3/8″ x each door size

2. Number — Eight sets 2/6 × 6/8, one set 3/0 × 6/8

D. Butt hinges (pairs)

1. Size — 3 1/2″

2. Number — Nine and one-half pairs

ANSWERS TO ASSIGNMENT SHEETS

E. Locksets

1. Type — Passage and privacy
2. Style — Streamline
3. Brand — Kwikset
4. Number of each — one privacy, eight passage

F. Other trim (lineal feet)

1. 7/16″ × 3″ san base — 78 feet
2. 7/16″ × 3/4″ shoe molding — 78 feet
3. 9/16″ × 2 1/4″ WP84 cove molding — 56 feet

INTERIOR DOORS AND TRIM
UNIT IV

JOB SHEET #1 — INSTALL INTERIOR DOOR FRAME, HANG DOOR, LOCK, AND TRIM

I. Tools and equipment

   A. Folding rule or steel tape

   B. 30-inch hand level and a 6-foot or jamb level

   C. Framing and try square

   D. Claw hammer

   E. Handsaw or power handsaw and extension cord

   F. Power planer

   G. Router with hinge-mortising bit and door-hanging kit

   H. Drill motor and drills

   I. Nail sets

   J. Flat-blade and phillips screwdrivers

   K. Self-centering punch

   L. Wood chisels

   M. Power miter saw or buck saw

   N. Door jack

   O. Sawhorses, one pair

   P. Door frames (5/8" × 4 5/8")

   Q. Door (2'−6" × 6'−8")

   R. Door spreader (1×6)

   S. Door casing

   T. Butt hinges

   U. Lockset with template

   V. Shingles for shims

JOB SHEET #1

W. Glue

X. 8d casing, 4d and 6d finish nails

Y. Utility knife

II. Procedures

A. Check rough opening for proper dimensions

(NOTE: Rough opening should be the same size as the door size plus 2 ½ inches width and 2 inches height.)

B. Check trimmer studs for plumb

C. Check header for level and square

D. Assemble door frame

(NOTE: Check length of side jambs with rough opening; sometimes it is necessary to cut off part of the lug on top of the side jambs before assembling. Do not cut off too much of the lug, or the assembled frame will not be strong enough.)

1. Fit the head jamb into the dado on the side jamb; glue and nail together with 6d galvanized nails

2. Fit head into dado on second jamb; glue and nail together with 6d galvanized nails

E. Install assembled door frame

1. Place frame in rough opening

2. Center frame in opening with side jambs resting on the floor and edges flush with wall face

3. Place a spreader on the floor between the side jambs

   (NOTE: Spreader should be the same length as the header between the two side jambs.)

4. Check to see that installation is properly aligned and that header is level

5. Determine swing of door and mark hinge side on the frame

6. Secure frame in opening, using shims at top and bottom on both sides of the frame and adjusting shims to plumb the jambs

7. Temporarily nail side jambs in place

   > **CAUTION**
   > Do not drive nails all the way in.

8. Insert shims at each hinge location to adjust for proper clearance

   (NOTE: One hinge is located 7 inches down from top of door, one hinge is 11 inches from bottom of door, and one is centered between the top and bottom hinges.)

9. Place intermediate shims where needed to make hinge jamb straight and plumb

10. Use 8d casing nails to secure jamb to trimmer studs

    (NOTE: Nail through jamb at each shim with nail located where it will be covered once the doorstop is installed.)

11. Repeat procedure to secure other side jamb, making sure to shim the jamb at the strike location

12. Recheck door frame for level, plumb, square, and straight

F. Install door casing

1. Select casing for the opening
2. Mark and cut head casing
3. Check head casing to see that it will fit properly
4. Cut miter on one end of both side casings
5. Turn side casing upside down; hold in place and mark cutoff position

   (NOTE: Position of the cut should be $^{3}/_{16}$ inch above the bottom edge of the door header jamb. This allows for the reveal.)

6. Follow same procedures to mark second side casing
7. Use power miter saw or buck saw to make the miter cuts on the casing
8. Temporarily nail head casing in place with 8d finish nails
9. Install side casings
   a. Place a small amount of glue on the two miters

JOB SHEET #1

b. Nail in place

(NOTE: Be sure to remove any excess glue with a damp cloth.)

10. Drive all nails in and complete nailing

    a. Use 4d or 6d finish nails, spaced about 16 inches apart, along inside edge

    b. Use 8d finish nails, spaced about 16 inches apart, along outside edge

11. Use nail set to set all exposed nail heads in the frame and casings

G. Prepare and install door

1. Check door dimensions with finished opening

   (NOTE: Maintain clearance of $^3/_{32}$ inch at top and both sides of door and about $^5/_8$ inch at bottom.)

2. Trim door if necessary

   a. Install door in door jack and lock in place

   b. Use power planer to trim door

   CAUTION

   Make very thin cuts with planer to avoid trimming off too much.

   c. Recheck door for proper fit

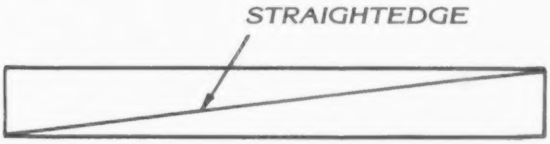
3. Bevel edge of door on lock side

   (NOTE: Bevel on edge of door should be approximately 3 to 5 degrees.)

   a. Use a straightedge to mark a line across the top edge of door from hinge corner of the door to opposite corner that will rest against the doorstop (Figure 43)

   EXAMPLE:

FIGURE 43

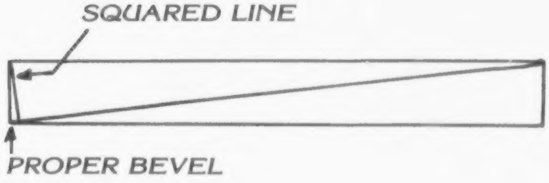


JOB SHEET #1

   b. Square a line from diagonal line to corner of door on edge opposite doorstop corner (Figure 44)

      EXAMPLE:

FIGURE 44



   c. Install door in door jack and lock in place

   d. Use power planer to cut proper bevel

4. Install butt hinges

   a. Position router hinge template on hinge edge of door, adjusting each hinge template to the hinge locations

   b. Set router for proper depth of cut

   c. Use router to cut gains for butt hinges

   d. Remove template from door

   e. Drill holes at screw locations

   f. Install hinges on door with loose pins toward top of door

   g. Attach router hinge template to door jamb, positioned to make matching cuts

   h. Use router to cut gains on the door frame

   i. Remove template from door jamb

   j. Drill holes at screw locations

   k. Install free leaf of hinges on the door jamb

JOB SHEET #1

5. Remove door from door jack and hang in place

6. Check clearance between door and door jambs; make necessary adjustments

H. Install doorstops

1. Measure and cut side stops to size

2. Miter top end of each side stop

   (NOTE: Be sure that miter cuts run down to inside of stop.)

3. Close door

4. Set stop for lock side tight against the door and nail in place with a 4d finish nail near each end and at 16-inch intervals

5. Set stop for hinge side with a 1/16-inch clearance and nail in place with a 4d finish nail near each end and at 16-inch intervals

6. Measure and cut head stop to size

7. Miter each end of head stop

8. Align head stop with the two side stops and nail in place with 4d finish nails near each end and at 16-inch intervals

9. Use nail sets to set all nails in the door unit

I. Install lock

1. Wedge door open so that it will not move

2. Measure 36 inches up from the floor and mark door at this point

3. Fold lockset template over edge of door at prescribed height line

   (NOTE: If boring jig is available, template is not necessary as the jig can be adjusted for different holes and door thicknesses.)

4. Mark centers of strike hole on door edge and lockset hole on face of door

5. Bore required lockset hole through door frame and then drill latch hole through door edge and into lockset hole

6. Mark location of latch plate and cut or chisel out gain

JOB SHEET #1

7. Install latch unit
8. Mark height line and vertical center line for strike on jamb
9. Cut mortise for strike
10. Install strike
11. Adjust lockset for thickness of door

    (NOTE: Follow manufacturer's instructions for adjusting lock.)

12. Install lockset in hole, making sure that lock case hooks the retainer legs and retractor bolt tails

    (NOTE: Follow manufacturer's instructions and details included with each lockset.)

13. Install inside rose plate if required; insert screws and tighten
14. If required, install rose plate on opposite side by snapping rose over retainer spring until it is tight against door
15. For a keyed or privacy lockset, lock from inside
16. Remove wedge from door, close door, and check to see if lock works properly
17. Adjust if required

J. Clean up area and put away tools and equipment

INTERIOR DOORS AND TRIM
UNIT IV

JOB SHEET #2 — INSTALL A SPLIT-JAMB PREHUNG DOOR UNIT

I. Tools and equipment

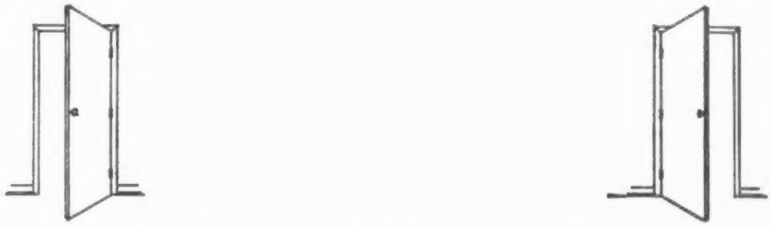
- A. Folding rule or steel tape
- B. 30-inch hand level and a 6-foot or jamb level
- C. Framing square and try square
- D. Claw hammer
- E. Handsaw
- F. Flat blade and phillips screwdriver
- G. Nail sets
- H. Sawhorses, one pair
- I. Prehung door unit
- J. Shingles for shims
- K. Glue
- L. Nails

II. Procedure

- A. Check that opening is correct size and that door is correct size and hand (Figure 45)

  (NOTE: Suppliers normally specify doors as either left- or right-hand without indicating reverse door swings. The carpenter must order the correct door for the application and install locksets to meet requirements.)

FIGURE 45



LEFT-HAND DOOR *RIGHT-HAND DOOR*

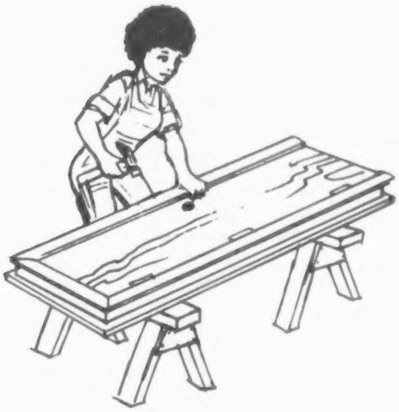
JOB SHEET #2

B. Uncrate door

1. Lay unit on sawhorses with hinges up

2. Remove small nails driven through jamb into the door on lock side (Figure 46)

FIGURE 46



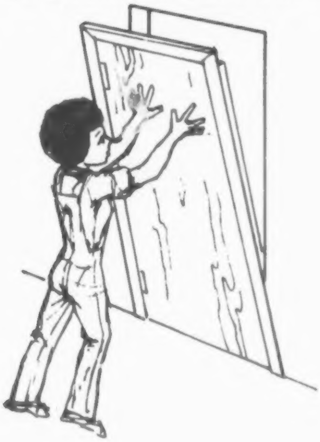
3. Separate the two halves by lifting the top half containing the door

4. Check for damage

C. Set door portion in the rough opening (Figure 47)

(NOTE: There are three spacer blocks between the door and the side jamb and three spacer blocks between the door and the head jamb on the back side.)

FIGURE 47



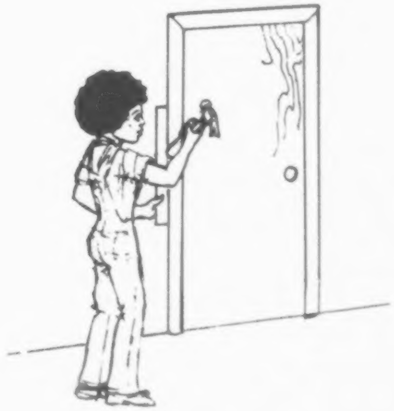
JOB SHEET #2

D. Check that jambs are against all spacer blocks and that both jambs are on the floor

E. Check trim for plumb (Figure 48)

(NOTE: When trim is plumb, the upper spacer block should be against the head jamb.)

FIGURE 48

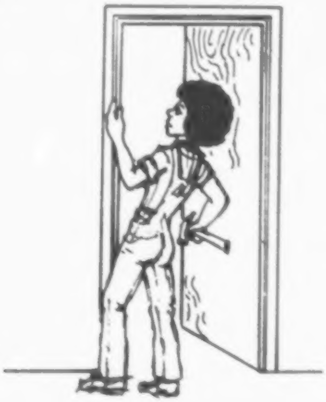


F. Nail trim to wall

(NOTE: On lock side of door, push the jamb tightly against the spacer blocks to maintain uniform clearance between the door and jamb before nailing trim.)

G. Move through doorway to other side of the door (Figure 49)

FIGURE 49



JOB SHEET #2

H. Shim between jamb and stud

  1. Close door

  2. Place shims at top and bottom and at each hinge on hinge side

  3. Place shims at top and bottom and at strike on lock side

I. Nail through jamb and shims into stud

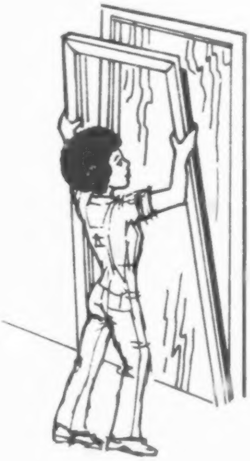
CAUTION
Do not nail through stop.

J. Remove spacer blocks

K. Insert remaining half of unit into grooved section containing the door (Figure 50)

(NOTE: This half will automatically be plumb.)

FIGURE 50

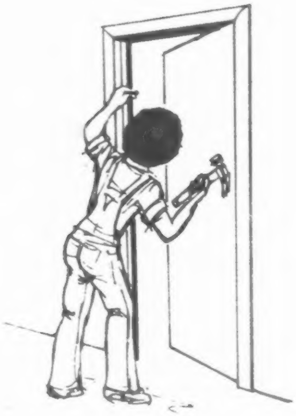


L. Nail trim to wall

M. Nail through stops and into studs (See Figure 51)

JOB SHEET #2

FIGURE 51



N. Install the lock

(NOTE: The door is predrilled for lock.)

O. Check operation of the door

(NOTE: When knob is released after retracting bolt, the bolt should snap out to its fully extended position. If it does not, loosen knob screws and reposition. Also check face of bolt for plumb.)

P. Clean up area and put away tools and equipment

INTERIOR DOORS AND TRIM
UNIT IV

JOB SHEET #3 — INSTALL A SOLID-JAMB PREHUNG DOOR UNIT

I. Tools and equipment

  A. Folding rule or steel tape

  B. 30-inch hand level and a 6-foot or jamb level

  C. Framing square

  D. Claw hammer

  E. Handsaw

  F. Nail sets

  G. Prehung door unit

  H. Wood shingles for shims

  I. 8d casing, 4d and 6d finish nails

II. Procedure

  A. Remove crate from door unit

  B. Check unit for damage

  C. Check rough opening for proper dimensions

  (NOTE: Rough opening should be the same as door size plus 2 1/2 inches for width and 2 inches for height.)

  D. Set unit centered in opening with installed trim tight against the wall

  E. Check for proper fit and alignment

  F. Open door and place a spreader on the floor between the two side jambs

  (NOTE: Spreader should be the exact length of the header jamb between the two side jambs.)

  G. Temporarily nail side jambs to hold unit in place; do not drive nails all the way in

  H. Insert double thickness of shingles at top and bottom of hinge jamb until plumb

  I. Nail jamb in position through shims

JOB SHEET #3

J. Insert shims at each hinge to adjust proper door clearance

K. Nail jamb at each hinge

L. Insert shims on lock jamb, starting at the top, then the bottom, then the center at the strike location

M. Nail lock jamb to rough framing through each set of shims

(NOTE: It will probably be necessary to add two more sets of shims between the top and center and bottom and center in order to adjust the proper door clearance.)

N. Remove spreader, close door, and check for proper door clearance

O. Cut off any shims that may protrude outside the frame

P. Nail trim to other side of door, spacing nails about 16 inches apart

Q. Clean up area and put away tools

INTERIOR DOORS AND TRIM
UNIT IV

JOB SHEET #4 — INSTALL A BIFOLD DOOR UNIT

I. Tools and equipment

- A. Folding rule or steel tape
- B. 30-inch hand level and a 6-foot or jamb level
- C. Framing and try square
- D. Claw hammer
- E. Handsaw
- F. Flat blade and phillips screwdriver
- G. Nail sets
- H. Drill motor, drills, and extension cord
- I. Power miter saw or buck saw
- J. Bifold package unit
- K. Shingles for shims
- L. Glue
- M. 8d casing, 4d and 6d finish nails

II. Procedure

- A. Install door frame, following procedures outlined in Job Sheet #1
- B. Install door track on header
- C. Install pivot brackets in frame
- D. Install pivots and door aligners on door
- E. Install doors
- F. Adjust doors to proper fit

  (NOTE: Folow instructions for installation and adjustment of bifold doors that are furnished with the unit by the manufacturer.)

- G. Install casing by following procedures outlined in Job Sheet #1
- H. Clean up area and put away tools and equipment

INTERIOR DOORS AND TRIM
UNIT IV

JOB SHEET #5 — INSTALL A POCKET DOOR UNIT

I. Tools and equipment

- A. Folding rule or steel tape
- B. 30-inch hand level and a 6-foot or jamb level
- C. Framing and try square
- D. Claw hammer
- E. Handsaw
- F. Flat blade and phillips screwdrivers
- G. Nail sets
- H. Drill motor, drills, and extension cord
- I. Power miter saw or buck saw
- J. Utility knife
- K. 2′-6″ × 6′-8″ pocket-door package unit
- L. Shingles for shims
- M. Glue
- N. 8d casing, 4d and 6d finish nails
- O. Piece of $^{3}/_{4}$-inch stock for a base plate (or floor anchor), screws and anchors if necessary

II. Procedure

(NOTE: Pocket door frames are normally installed during the framing phase of construction.)

- A. Check rough opening for proper dimensions, trimmer studs for plumb, and header for level and square
- B. Set frame unit in opening
- C. Install frame, using same procedures as outlined in Job Sheet #1

JOB SHEET #5

D. Cut base plate to fit between side frames in pocket section

E. Install base plate on the floor, using glue and appropriate anchors, depending on type of floor

F. Nail side frames to the base plate

(NOTE: Follow instructions for installation and adjustment furnished with the unit by the manufacturer.)

G. Install wall material over frame

CAUTION

Take care not to drive nails into the door.

H. Install casing by following procedures outlined in Job Sheet #1

I. Clean up area and put away tools and equipment

INTERIOR DOORS AND TRIM
UNIT IV

JOB SHEET #6 — INSTALL WINDOW TRIM

I. Tools and materials

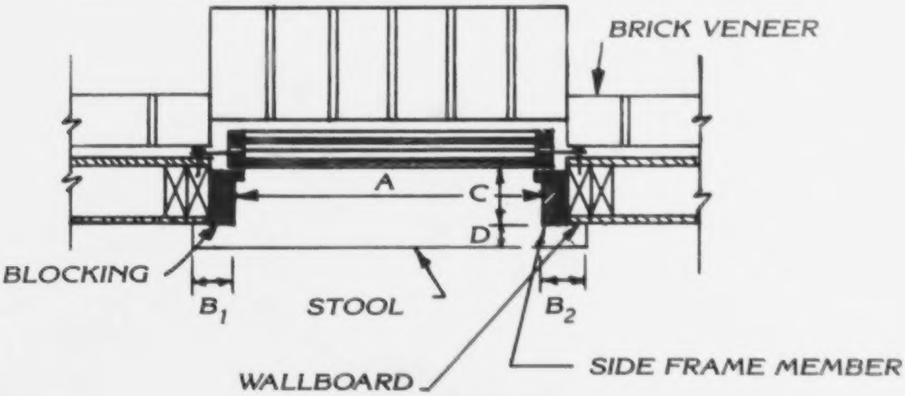
- A. Radial arm or table saw
- B. Power miter saw and extension cord
- C. Handsaw
- D. Claw hammer
- E. Try square
- F. Folding rule or steel tape
- G. Nail set
- H. Casing, stool, and material
- I. 4d, 6d, and 8d finish nails

II. Procedure

- A. Install stool
  - 1. Lay out and cut to size (Figure 52)
    - a. Measure distance between the side jambs (dimension A)
    - b. Add dimensions B_1 and B_2 as specified to dimension A for length of stool
    - c. Measure distance from the window unit to the inside edge of the side frame for dimension C
    - d. Add dimension D to dimension C for width of the stool

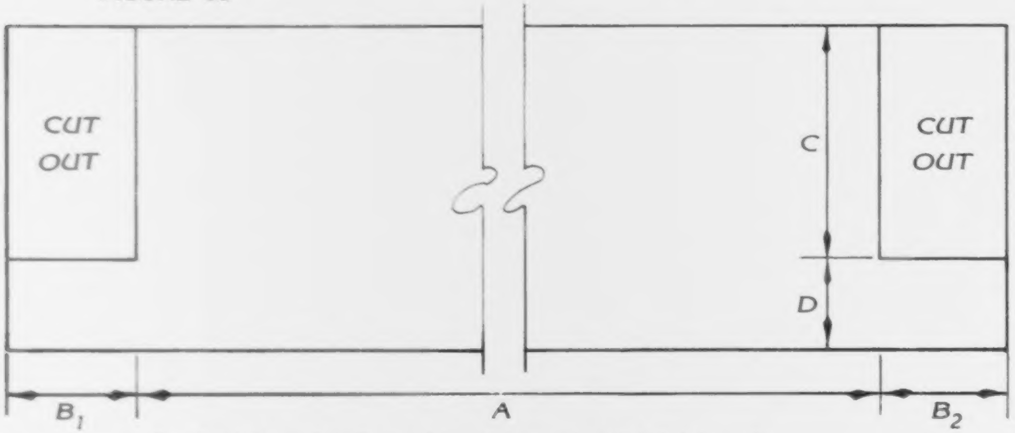
      (NOTE: Dimension D will depend on window style.)

FIGURE 52



e. Lay out stool and cut (Figure 53)

FIGURE 53


CUT OUT
CUT OUT
C
D
B1
A
B2

2. Install and nail stool in place, using 8d finish nails

(NOTE: Use shims to raise sill to proper height; sill must fit snug between frames and the window unit.)

B. Case window

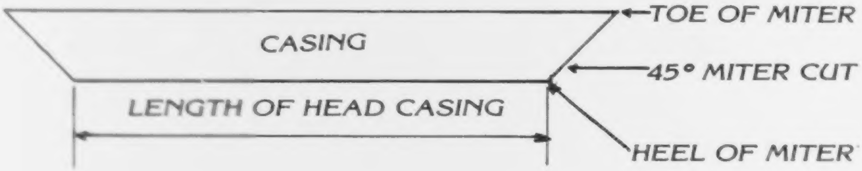
1. Cut head casing (Figure 54)

a. Measure distance between the side frames

b. Add 3/8 inch for the 3/16-inch reveal on both side frames

(NOTE: This is the measurement for the heel of the 45-degree cuts.)

FIGURE 54


CASING
LENGTH OF HEAD CASING
TOE OF MITER
45° MITER CUT
HEEL OF MITER

2. Cut casing for sides (See Figure 55)

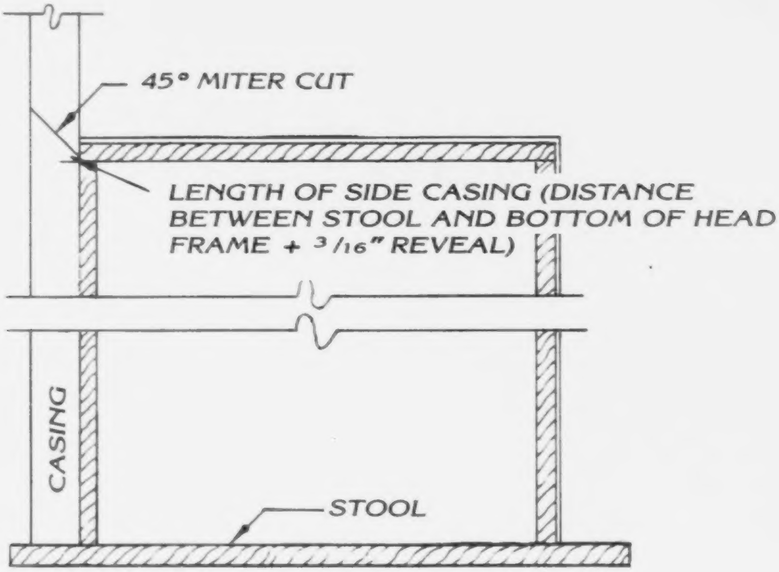
a. Measure from top of stool to bottom face of head frame

b. Add 3/16 inch for the reveal on the frame

JOB SHEET #6

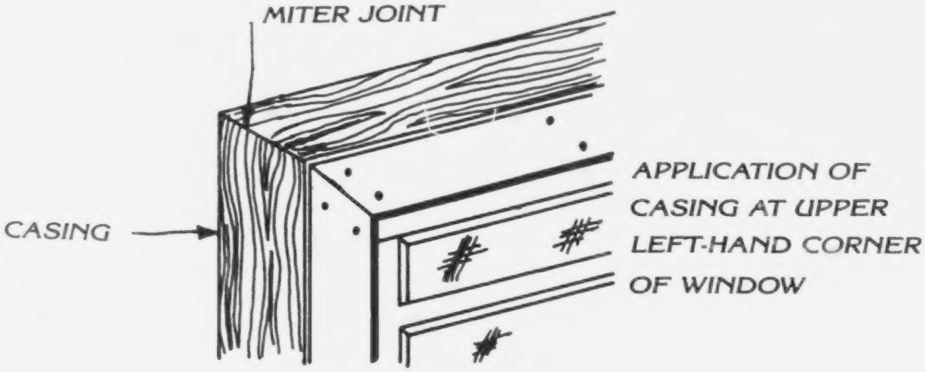
c. Cut two sides for window

FIGURE 55


45° MITER CUT
LENGTH OF SIDE CASING (DISTANCE BETWEEN STOOL AND BOTTOM OF HEAD FRAME + 3/16" REVEAL)
CASING
STOOL

3. Install casing (Figure 56)

FIGURE 56


MITER JOINT
CASING
APPLICATION OF CASING AT UPPER LEFT-HAND CORNER OF WINDOW

NOTE TIGHT FIT OF MITER JOINT

(NOTE: Be sure miter fits tight all the way across.)

a. Check head casing to see that it fits properly

b. Nail side casings temporarily in place with 6d finish nails

JOB SHEET #6

c. Place small amount of glue on miter joints, then nail head casing with 6d nails near ends and spaced 16 inches between

d. Wipe excess glue from miters with a damp cloth

e. Drive nails until heads are about $^{1}/_{16}$ inch above casing

f. Use nail set to drive nails final distance

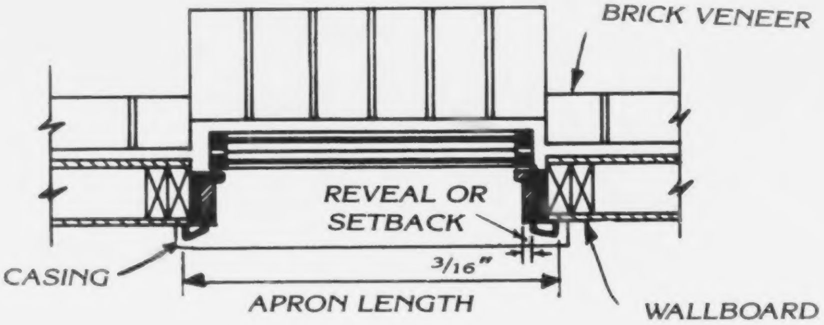
(NOTE: It is advisable to drill nail holes in all casing and trim when using hardwoods.)

C. Cut and install apron

(NOTE: Apron length should be equal to the distance between outside edges of the side casing.)

1. Measure distance between the outside edges of the side casing (Figure 57)

FIGURE 57



2. Transfer measurement to the apron

3. Cut apron to length

4. Miter or shape ends

5. Nail in place directly under the stool, using 6d finish nails (See Figures 58 and 59)

JOB SHEET #6

FIGURE 58

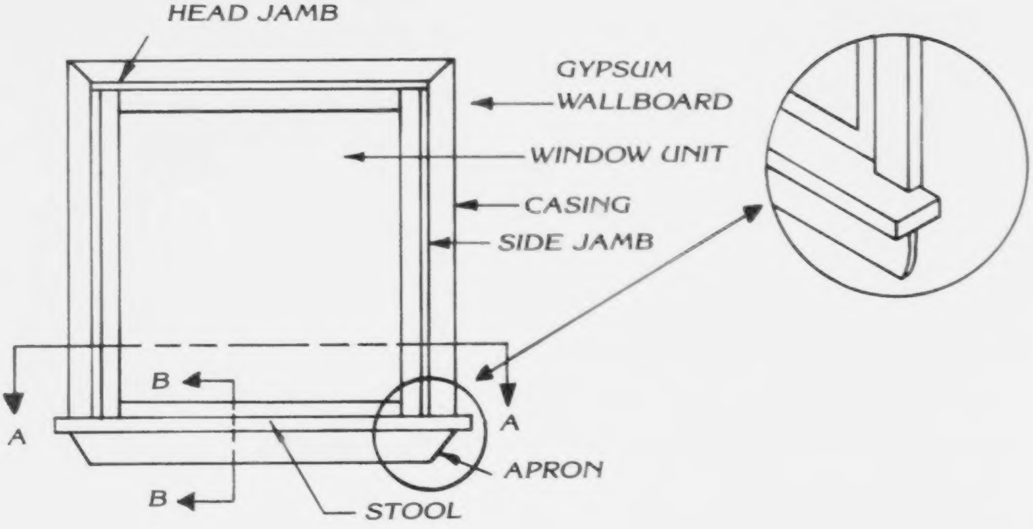
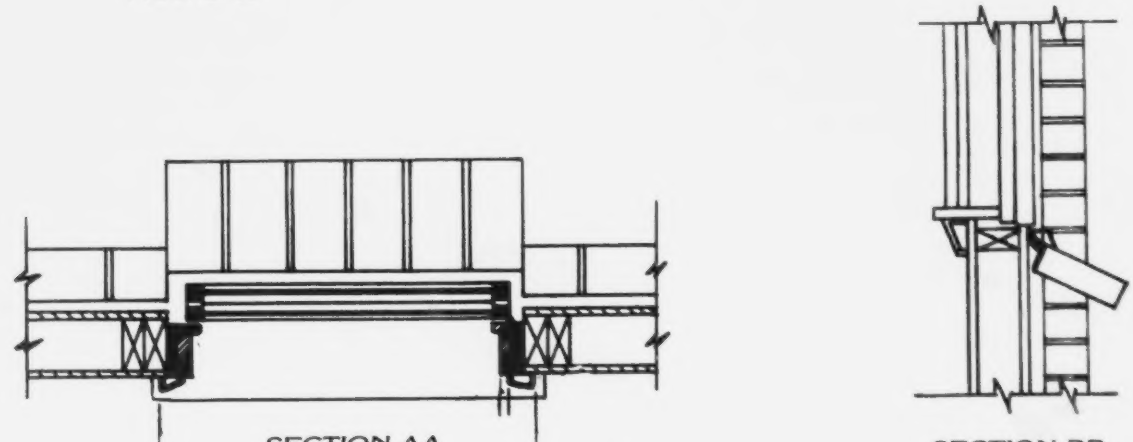

HEAD JAMB
GYPSUM WALLBOARD
WINDOW UNIT
CASING
SIDE JAMB
A
A
B
B
APRON
STOOL

FIGURE 59


SECTION AA

SECTION BB

D. Clean work area and put away tools and equipment

INTERIOR DOORS AND TRIM
UNIT IV

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with interior doors and trim to their correct definitions. Write the correct numbers in the blanks. Definitions are continued on the next page.

______a. Horizontal trim immediately under a window stool

______b. Finish molding covering bottom edge of wall material where the wall and floor meet

______c. Molding or trim attached to inside edge of one of a pair of doors or windows to prevent swinging through; also used with sliding doors to ensure tighter fit where doors meet

______d. Molding nailed to the wall at top edge of wainscot panel

______e. Framework of trim of various widths and thicknesses used around windows and doors

______f. Narrow strips of wood or metal trim used to cover joints of sheathing or other materials to seal the joints

______g. Spacing between edge of door and jamb, and between jamb and trimmer stud

______h. To cut or shape the end of a piece of molding so that it fits the contour of an adjoining piece of molding

______i. Assembly of wood parts that form an enclosure and support for a door

______j. Molding nailed to the faces of a door frame to prevent door from swinging through

______k. Small post with rubber tip, installed to limit the swing of a door in order to protect door, wall, or another door

______l. Device used to guide tools or materials when performing a particular job

______m. Joint between two pieces of material at an angle that bisects the angle of junction

1. Cope
2. Template
3. Base
4. Door frame
5. Batten
6. Miter joint
7. Doorstop or bumper
8. Clearance
9. Casing
10. Reveal
11. Apron
12. Jig
13. Astragal
14. Doorstop molding
15. Cap molding

TEST

______n. Gauge or pattern used as a guide to form or shape pieces being made

______o. Space or setback between casing or trim and the edge of door or window frame; usually $^3/_{16}$ inch to $^3/_8$ inch

2. State the general types of interior door construction.

   a. ______________________________

   b. ______________________________

3. State the basic classifications of interior doors.

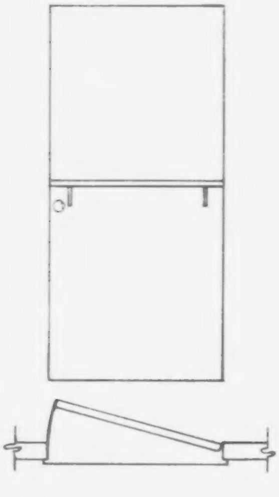
   a. ______________________________

   b. ______________________________

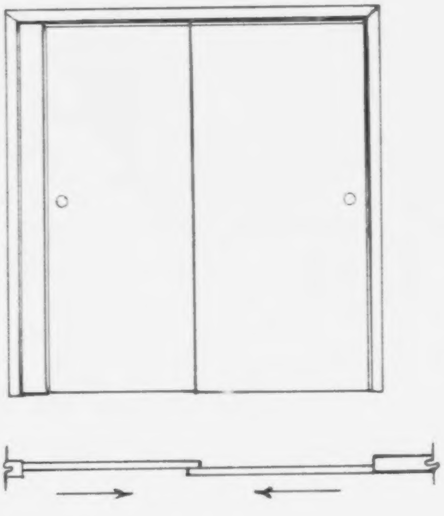
   c. ______________________________

4. Identify types of interior doors. Write the correct names in the blanks.

Flush
Panel
Louver
French
Dutch
Cafe
Bifold
Sliding pocket
Bipass sliding
Multifold or accordian

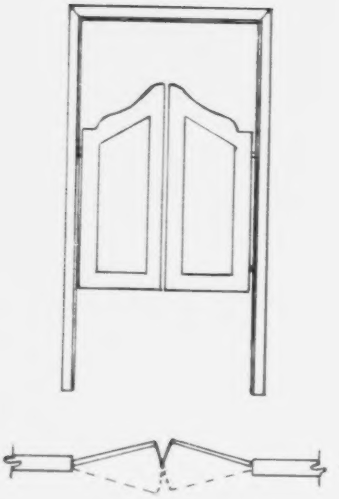


a. ______________________________

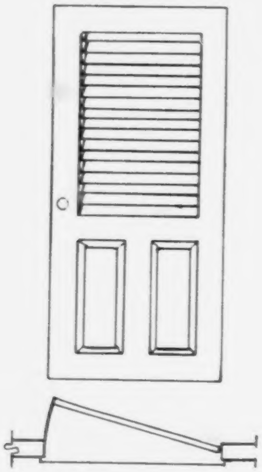


b. ______________________________

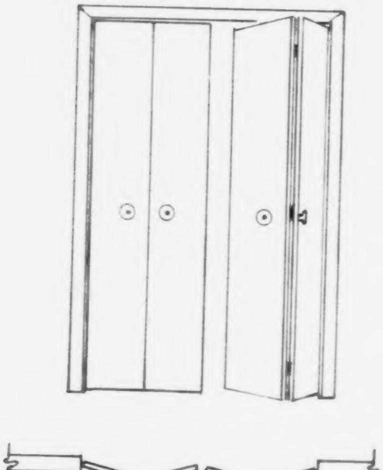
TEST



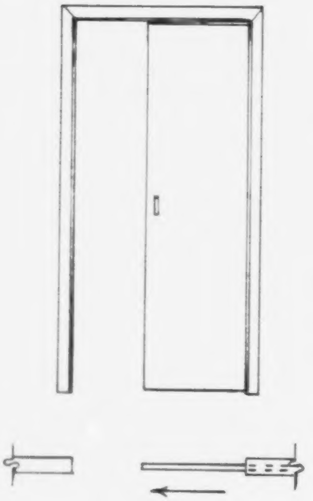
c. ______________________________



d. ______________________________

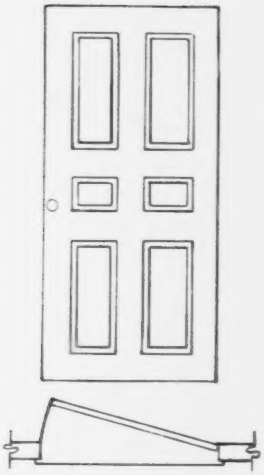


e. ______________________________

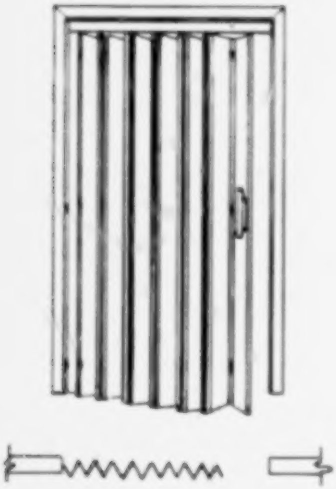


f. ______________________________

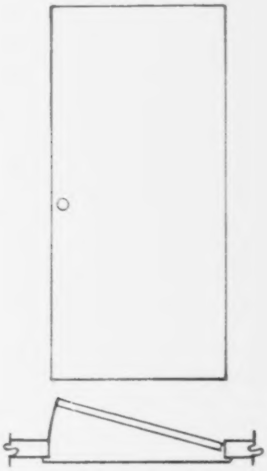
TEST



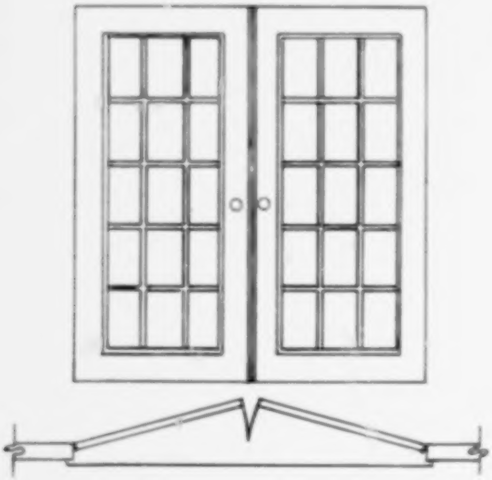
g. ______________________________



h. ______________________________



i. ______________________________

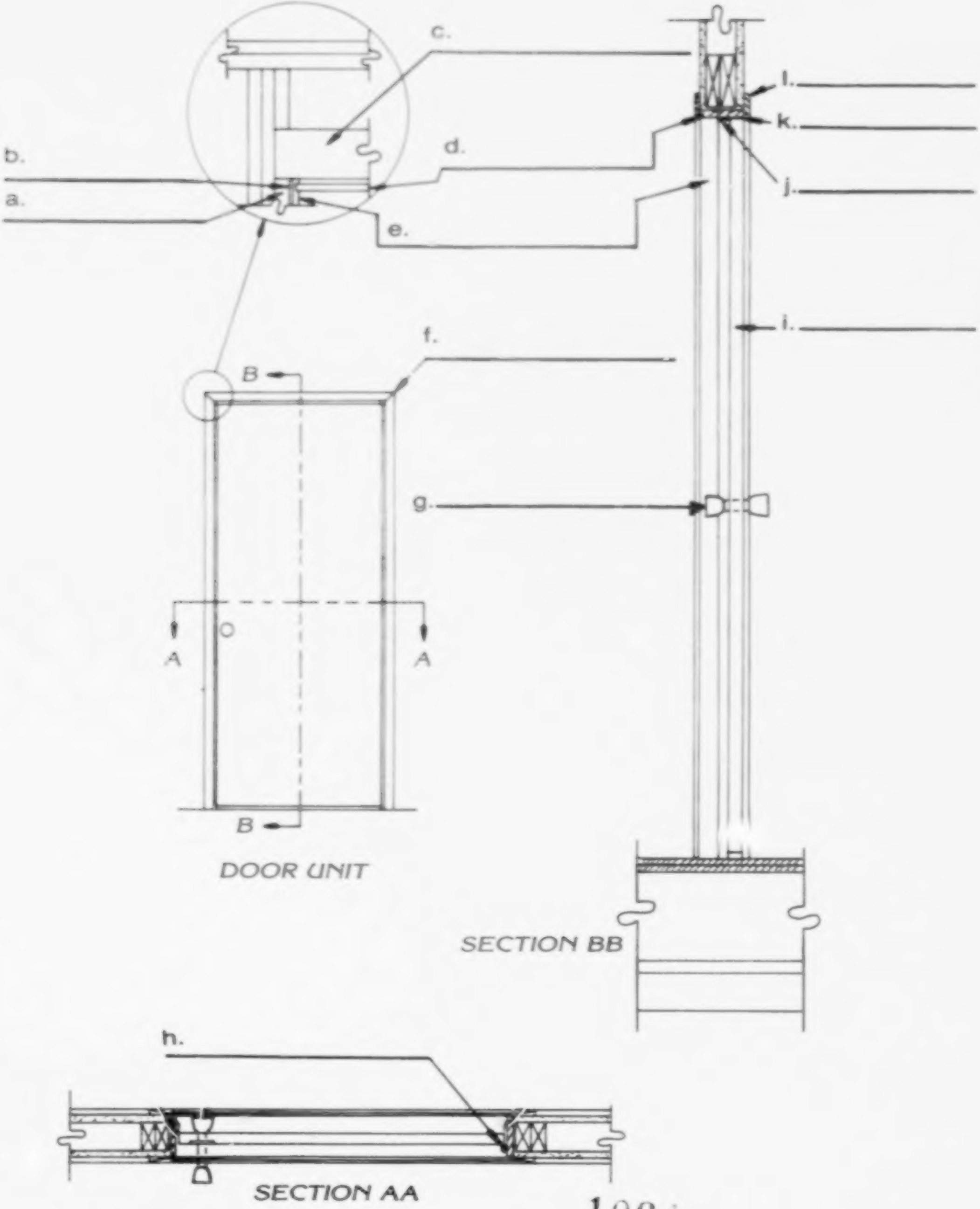


j. ______________________________

TEST

5. Identify parts of an interior door unit. Write the correct names in the blanks.

Door
Lockset
Head jamb
Miter joint
Side jamb
Interior trim
Trimmer stud
Door clearance
Rough header
Blocking
Butt hinge
Doorstop molding


c.
b.
d.
a.
e.
l.
k.
j.
i.
f.
B
B
g.
A
A
DOOR UNIT
SECTION BB
h.
SECTION AA

TEST

6. Select from the following list standard sizes of interior doors and jambs. Write an "X" in the blank before each correct answer.

_____a. 2′-8″ × 6′-8″ × 1 3/8″

_____b. 4′-0″ × 6′-0″ × 1″

_____c. 3′-0″ × 6′-8″ × 1 3/8″

_____d. 3′-6″ × 7′-0″ × 1 3/8″

_____e. 2′-6″ × 6′-8″ × 1 3/8″

_____f. 2′-4″ × 6′-8″ × 4 5/8″

_____g. 4′-0″ × 7′-10″ × 1″

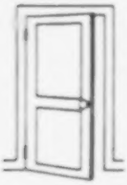
_____h. 3′-6″ × 7′-0″ × 5 1/4″

_____i. 2′-0″ × 6′-8″ × 1 3/8″

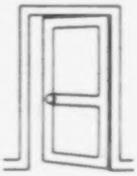
_____j. 4′-0″ × 6′-8″ × 1″

7. Identify hand of a door. Write the correct hand in the blanks.

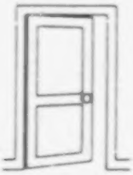
Left hand **Right hand reverse** **Right hand** **Left hand reverse**



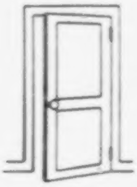
a. ______________________________



b. ______________________________



c. ______________________________



d. ______________________________

8. Select from the following list recommended finish clearances and dimensions for hanging doors. Write an "X" in the blank before each correct answer.

Clearance

_____a. Top of door - 9/16 inch

_____b. Bottom of door - 5/8 inch

_____c. Hinge side of door - 3/32 inch

_____d. Lock side of door - 9/16 inch

TEST

Dimensions

______e. Top hinge 11 inches from top of door

______f. Bottom hinge - 11 inches from bottom of door

______g. Center hinge - centered on door

______h. Doorknob - 36 inches from floor

9. Compute rough opening for the following doors.

   a. 2′ – 4″ × 6′ – 8″

      1) Width — ______________

      2) Height — ______________

   b. 2′ – 8″ × 6′ – 8″

      1) Width — ______________

      2) Height — ______________

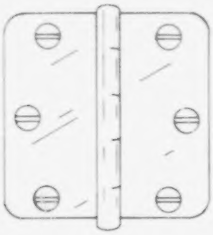
   c. 3′ – 0″ × 7′ – 0″

      1) Width — ______________

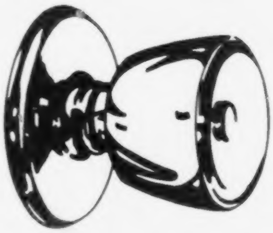
      2) Height — ______________

10. Identify hardware used with interior doors. Write the correct names in the blanks. An answer may be used more than once.

Passage lockset
Pocket-door hardware
Sliding-door edge pull
Doorknob or pull
Doorstop
Privacy lockset
Keyed lockset
Sliding-door hardware
Bifold-door hardware
Butt hinge
Recessed door pull

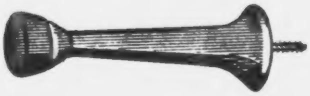


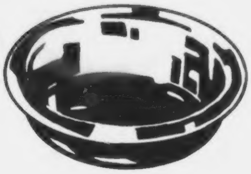
a. ______________________________



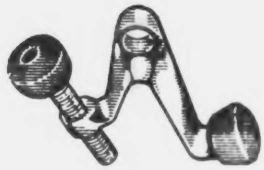
b. ______________________________

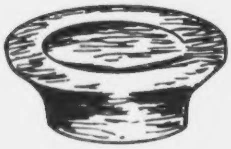
TEST



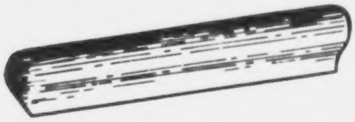


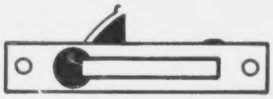
c. ______________________ d. ______________________



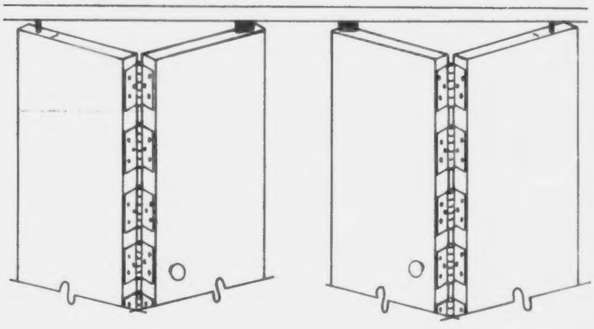


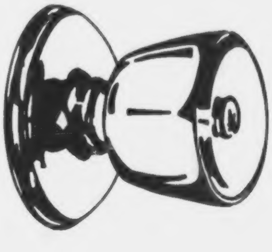
e. ______________________ f. ______________________





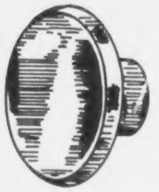
g. ______________________ h. ______________________



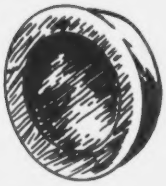


i. ______________________ j. ______________________

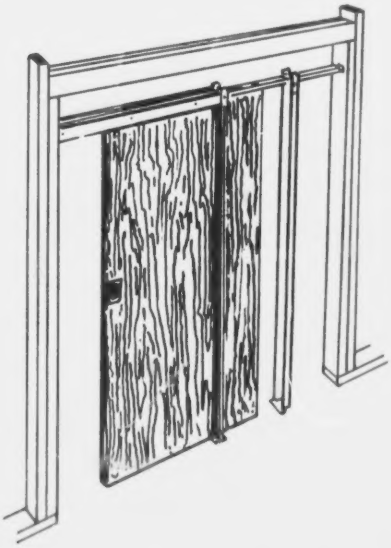
TEST



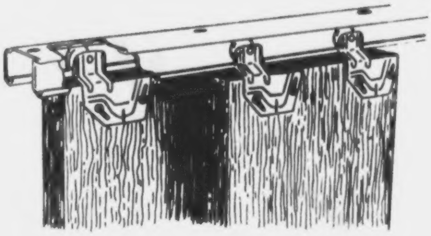
k. ______________________



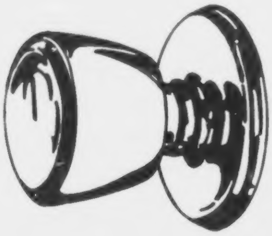
l. ______________________



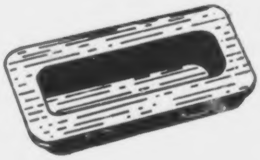
m. ______________________



n. ______________________



o. ______________________

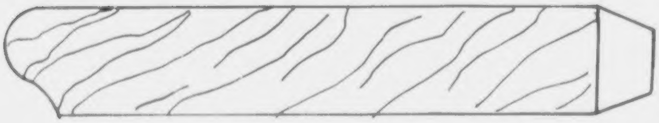


p. ______________________

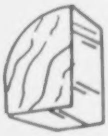
TEST

11. Identify types of interior trim. Write the correct names in the blanks.

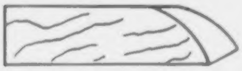
Base
Outside corner
Shoe molding (base shoe)
Cap molding (cap strip)
Casing
T-astragal
Chair rail
Batten
Doorstop molding
Cove
Inside corner
Quarter round
Crown
Window stool



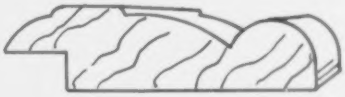
a. ______________________________



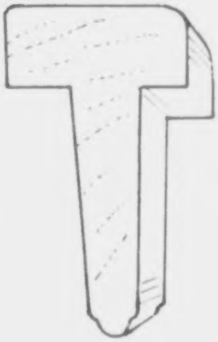
b. ______________________________



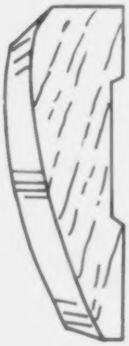
c. ______________________________



d. ______________________________

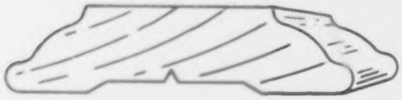
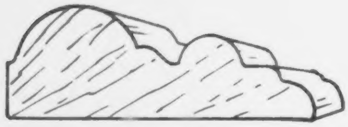


e. ______________________________



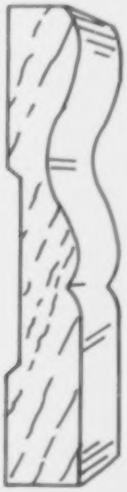
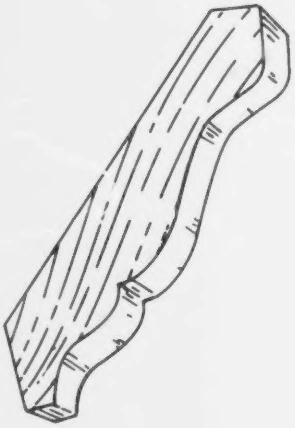
f. ______________________________

TEST

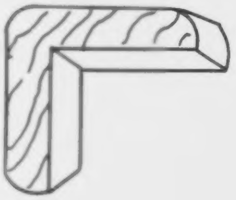
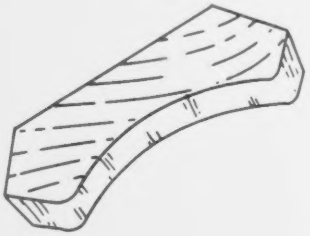
g. ______________________________

h. ______________________________

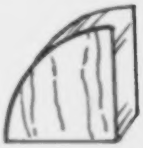
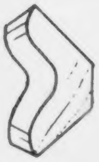
i. ______________________________

j. ______________________________

k. ______________________________

l. ______________________________

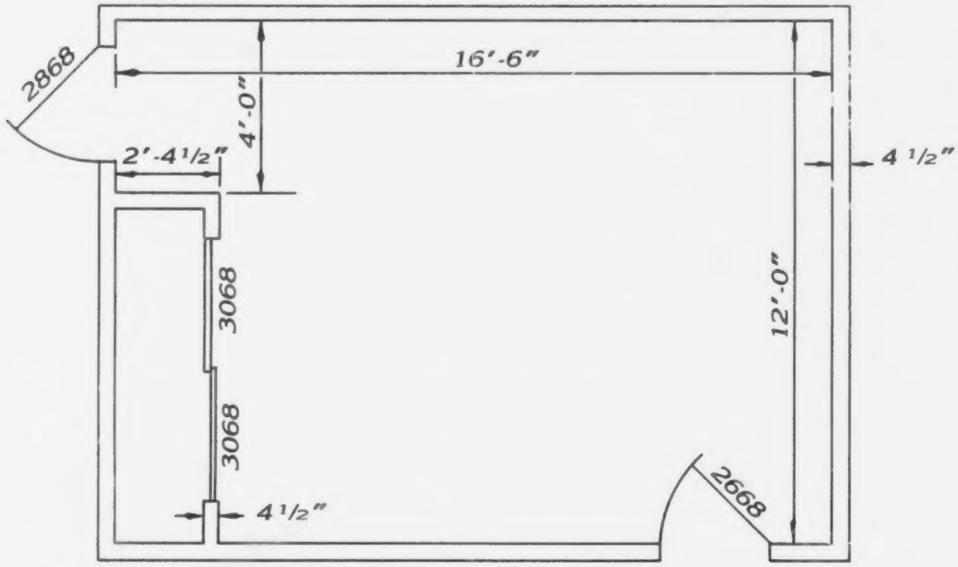



m. ______________________________

n. ______________________________

TEST

12. Estimate material needed to trim inside the room illustrated.



Use the following trim items: 5/8" × 3 1/2" colonial base; 5/8" × 2 1/2" colonial casing; 7/16" × 3/4" shoe molding ; 1" × 1" outside corner molding; Stanley 400 privacy lockset and three 3 1/2" butt hinges on each hollow-core flush door; 7/16" × 1 3/8" O.G. doorstops; 9/16" × 3 1/4" WP51 crown molding.

a. Doors
   1) Type — ______________
   2) Size — ______________
   3) Number — ______________

b. Jamb (sets)
   1) Size — ______________
   2) Number — ______________

c. Casing and doorstop sets
   1) Type and size — ______________
   2) Number — ______________

d. Butt hinges (pairs)
   1) Size — ______________
   2) Number — ______________

e. Locksets
   1) Type — ______________
   2) Style — ______________
   3) Brand — ______________
   4) Number — ______________

f. Other trim (lineal feet)
   1) Base — ______________
   2) Shoe molding — ______________
   3) Crown molding — ______________
   4) Corners — ______________

TEST

(NOTE: Test question 13 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

13. Demonstrate the ability to

    a. Install interior door frame, hang door, lock, and trim.

    b. Install a split-jamb prehung door unit.

    c. Install a solid-jamb prehung door unit.

    d. Install a bifold door unit.

    e. Install a pocket door unit.

    f. Install window trim.

INTERIOR DOORS AND TRIM
UNIT IV

ANSWERS TO TEST

1. a. 11
   b. 3
   c. 13
   d. 15
   e. 9
   f. 5
   g. 8
   h. 1
   i. 4
   j. 14
   k. 7
   l. 12
   m. 6
   n. 2
   o. 10

2. Answer should include the following
   a. Hollow core
   b. Solid core

3. Answer should include the following
   a. Swinging
   b. Sliding
   c. Folding

4. a. Dutch
   b. Bipass sliding
   c. Cafe
   d. Louver
   e. Bifold
   f. Sliding pocket
   g. Panel
   h. Multifold or accordian
   i. Flush
   j. French

5. a. Trimmer stud
   b. Blocking
   c. Rough header
   d. Head jamb
   e. Side jamb
   f. Miter joint
   g. Lockset
   h. Butt hinge
   i. Door
   j. Doorstop molding
   k. Door clearance
   l. Interior trim

6. a, c, e, f, g, i, j

7. a. Left hand reverse
   b. Right hand
   c. Left hand
   d. Right hand reverse

8. b, c, f, h

ANSWERS TO TEST

9. Answer should include the following
   a. 1) Width — 2'-6 7/16" or 2'-6 1/2"
      2) Height — 6'-9 27/32" or 6'-10"

   b. 1) Width — 2'-10 7/16" or 2'-10 1/2"
      2) Height — 6'-9 27/32" or 6'-10"

   c. 1) Width — 3'-2 7/16" or 3'-2 1/2"
      2) Height — 7'-1 27/32" or 7'-2"

10. a. Butt hinge
    b. Privacy lockset
    c. Doorstop
    d. Recessed door pull
    e. Doorstop
    f. Doorknob
    g. Door pull
    h. Sliding-door edge pull
    i. Bifold-door hardware
    j. Keyed lockset
    k. Doorknob
    l. Recessed door pull
    m. Pocket-door hardware
    n. Sliding-door hardware
    o. Passage lockset
    p. Recessed door pull

11. a. Window stool
    b. Shoe molding (base shoe)
    c. Doorstop molding
    d. Cap molding (cap strip)
    e. T-astragal
    f. Casing
    g. Batten
    h. Chair rail
    i. Base
    j. Crown
    k. Outside corner
    l. Cove
    m. Quarter round
    n. Inside corner

12. Answer should include the following

    (NOTE: Because estimating answers will vary considerably, answers should be evaluated to the satisfaction of the instructor.)

    a. Doors
       1) Hollowcore flush, bipass sliding
       2) 2668 × 1 3/8", 2868 × 1 3/8", 3068 × 1 3/8"
       3) One 2/6, one 2/8, and two 3/0
    b. Jamb (sets)
       1) 2/6, 2/8, and two 6/0
       2) One 2/6, one 2/8, and one 6/0
    c. Casing and doorstop sets
       1) 5/8" × 2 1/2" colonial casing, 7/16" × 1 3/8" O.G. doorstops
       2) One set for each swinging door frame
          Two sets for sliding door frame
    d. Butt hinges (pairs)
       1) 3 1/2"
       2) 6 hinges or 3 pairs

ANSWERS TO TEST

e. Locksets
  1) Privacy
  2) 400
  3) Stanley
  4) Two sets
f. Other trim (lineal feet)
  1) 60 lineal feet of 5/8″ × 3 1/2″ colonial base
  2) 60 lineal feet of 7/16″ × 3/4″ shoe molding
  3) 58 lineal feet of 9/16″ × 3 1/4″ WP51 crown molding
  4) One piece 1″ × 1″ × 8′ outside corner

13. Performance skills evaluated to the satisfaction of the instructor

CABINETS AND SPECIAL BUILT-INS
UNIT V

UNIT OBJECTIVE

After completing this unit, the student should be able to identify parts of a cabinet and should be able to install cabinets and shelves. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with cabinet installation and special built-ins to their correct definitions.
2. Name types of cabinets.
3. Identify parts of a cabinet.
4. Name the standard sizes of base and top cabinets.
5. Label types of cabinet-door installation.
6. Label styles of cabinet doors.
7. Label types of joints used in cabinet construction.
8. Identify hardware used on cabinets.
9. List types of material used on counter tops.
10. List types of special built-ins.
11. Demonstrate the ability to
    a. Install a custom-built cabinet.
    b. Install shelves in a closet.

CABINETS AND SPECIAL BUILT-INS
UNIT V

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Transparency masters

      1. TM #1 — Parts of a Cabinet

      2. TM #2 — Types of Cabinet-Door Installations

   D. Information sheet

   E. Job sheets

      1. Job Sheet #1 — Install a Custom-Built Cabinet

      2. Job Sheet #2 — Install Shelves in a Closet

   F. Test

   G. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

   B. Obtain materials needed to supplement presentation.

   (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364 or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

   C. Introduce unit.

   SUGGESTIONS:

   - Use plans or catalogs from a company specializing in cabinetry and built-ins to show the variety of installations.
   - Invite a cabinetmaker to talk to the class about the nature of the work; get a former student of your program who has specialized in cabinetmaking if possible.

SUGGESTED ACTIVITIES

D. Provide students with objective sheet.

E. Discuss unit and specific objectives, relating the objectives to each other, to previous units, and to your introduction of the unit.

F. Provide students with information sheet.

G. Discuss information sheet.

1. Use Information Sheet, Section I to discuss terms and definitions associated with cabinets and built-ins.

   SUGGESTIONS:

   - Use actual samples of materials whenever possible.
   - Provide students with photographs or magazine illustrations of cabinets and built-ins picturing the terms discussed.

2. Use Information Sheet, Section II to discuss types of cabinets.

   SUGGESTIONS:

   - Visit a construction site or have a trim carpenter discuss job-built cabinets and built-ins.
   - Visit a mill or cabinet shop or have a representative from such a company show the class samples of their products and discuss their construction methods.
   - Visit a factory that produces modular units or have a factory representative show the class samples of their products and discuss their manufacturing methods.

3. Use Information Sheet, Section III and Transparency #1 to discuss parts of a cabinet.

   SUGGESTIONS:

   - Use a cutaway of a cabinet to show the parts.
   - Mask the part names on the transparency and quiz the students on the identity of the parts.

4. Use Information Sheet, Section IV to discuss standard sizes of cabinets.

   SUGGESTIONS:

   - Emphasize the need for standard sizes of cabinets by discussing architectural drawings, appliance sizes, the use of manufactured doors or counter tops on job-built cabinets, etc.

SUGGESTED ACTIVITIES

- Use Transparency #1 or a display model to illustrate the dimensions being discussed.

- Have students lay out cabinets on floor plans of various sizes of rooms.

5. Use Information Sheet, Section V, Transparency #2, and Section VI to discuss cabinet-door designs and installations.

   SUGGESTIONS:

   - Provide the class with magazines showing the various types and styles of doors in place and relate the various installations to appearance effects.

   - At a construction site, have students classify the types and styles of cabinet doors being used.

   - Visit a cabinet shop or set up a class demonstration to show how the various types and styles of doors are made.

6. Use Information Sheet, Section VII to discuss types of joints used in cabinet construction.

   SUGGESTIONS:

   - Provide class with samples of each type of joint and discuss their locations in the cabinet and their purposes.

   - Visit a cabinet shop or demonstrate the production of the various joints, using shop tools.

7. Use Information Sheet, Section VIII to discuss cabinet hardware.

   SUGGESTIONS:

   - Provide the class with a variety of actual samples of hardware, emphasizing differences not only in design but also in styles, finishes, and sizes.

   - Relate specific hardware to its use, showing installed hardware as much as possible; also relate hardware to location in a cabinet and to specific uses such as compatibility with a particular type of door.

   - Make flash cards of the various types of hardware; drill students with cards.

SUGGESTED ACTIVITIES

8. Use Information Sheet, Section IX to discuss types of materials used for counter tops, emphasizing that these materials may be applied over a submaterial.

   SUGGESTIONS:

   - Provide the class with samples of the various types of materials and illustrations of the materials installed.

   - Discuss specific uses of each, especially the use of combinations of these materials for special purposes such as a plastic-laminate counter top with a butcher-block section in the food-preparation area and a ceramic-tile section near the stove.

9. Use Information Sheet, Section X to discuss types of special built-ins.

   SUGGESTIONS:

   - Use catalogs or manufacturer's representatives to illustrate the variety of built-ins used.

   - Provide the students with house plans and have them identify requirements for special built-ins, especially by using cabinet and closet details.

   - Discuss the various types of mill work available for use as special built-ins, and have students estimate material requirements.

H. Provide students with job sheets.

I. Discuss and demonstrate job sheet procedures; allow students to practice job sheet procedures.

J. Review unit.

K. Give test.

L. Critique test and discuss in class.

M. Reteach and retest as required.

N. Complete appropriate sections of competency profiles.

III. Unit references

A. Gasper, Lewis J. *Carpentry.* Albany, New York: Delmar Publishers, Inc., 1984.

B. Haynie, Paul. *Cabinetmaking*. Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1976.

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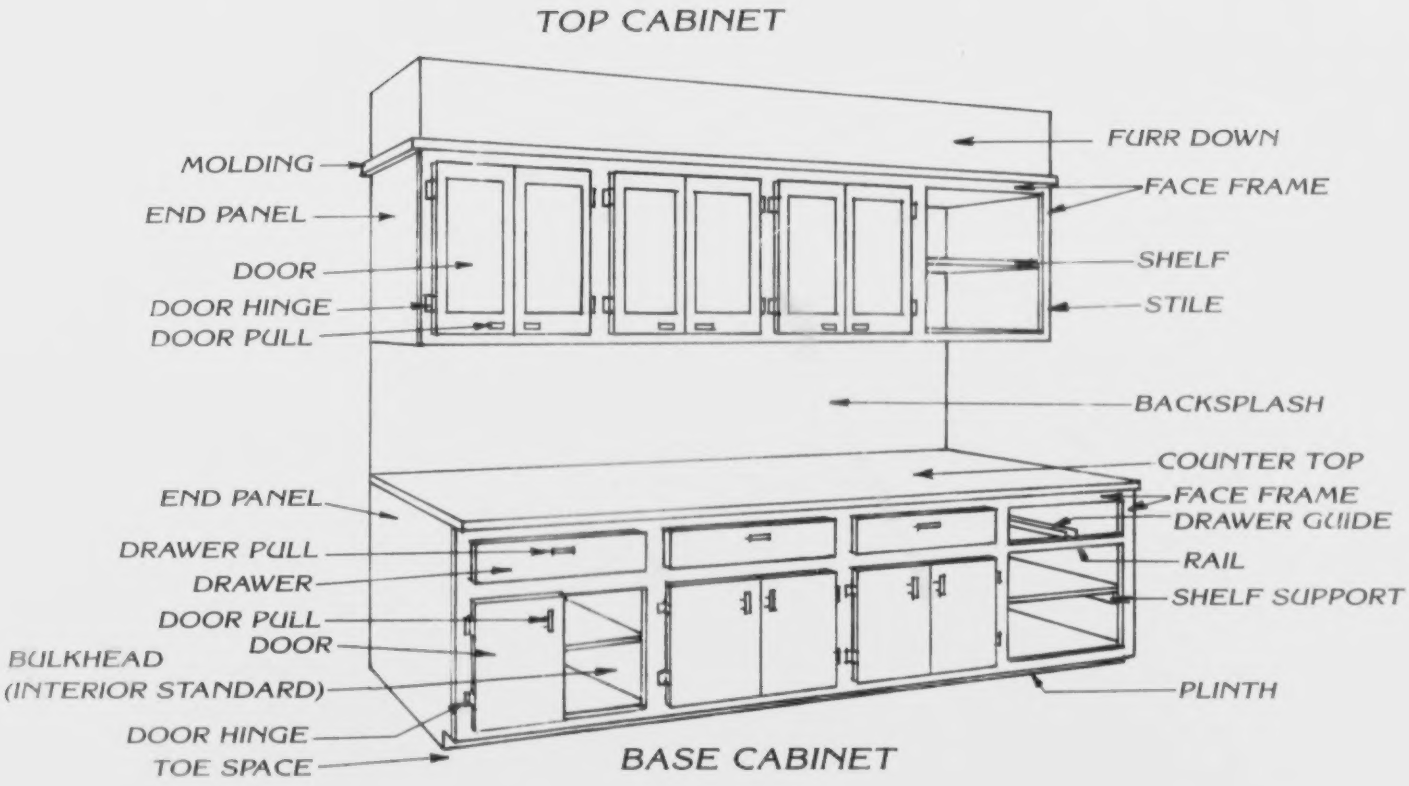
SUGGESTED ACTIVITIES

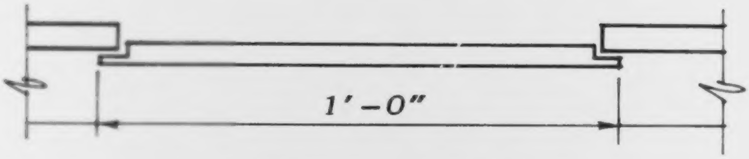
C. Hendrix, Laborn J. "Bud." *Commercial Carpentry*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1979.

Parts of a Cabinet

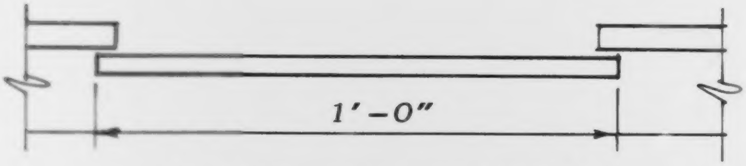

TOP CABINET
FURR DOWN
MOLDING
FACE FRAME
END PANEL
SHELF
DOOR
STILE
DOOR HINGE
DOOR PULL
BACKSPLASH
COUNTER TOP
END PANEL
FACE FRAME
DRAWER GUIDE
DRAWER PULL
RAIL
DRAWER
SHELF SUPPORT
DOOR PULL
DOOR
BULKHEAD
(INTERIOR STANDARD)
PLINTH
DOOR HINGE
TOE SPACE
BASE CABINET

THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA

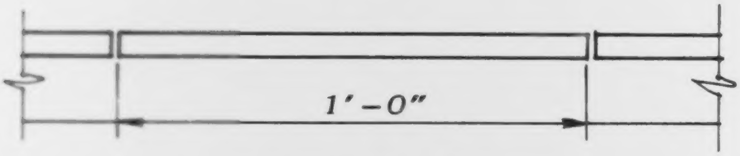
Types of Cabinet-Door Installations



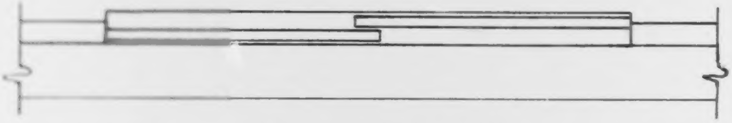
LIPPED (INSERT) DOOR



SURFACE (OVERLAY) DOOR



FLUSH DOOR



SLIDING DOOR

CABINETS AND SPECIAL BUILT-INS
UNIT V

INFORMATION SHEET

I. Terms and definitions

   A. Base cabinet — Cabinet unit that sits on the floor

   B. Counter top — Preformed or shop-built top of base unit

   C. Top or wall cabinet — Cabinet unit attached to wall above base unit

   D. Special built-ins — Job-built units pieced together in their permanent location

   E. Ceramic tile — Nonmetallic mineral tile produced by firing at high temperatures

   F. Quarry tile — Glazed or unglazed tile made by extrusion process from natural clay or shale

   G. Extrusion — Process of forming into a particular shape and size by forcing, pressing, or pushing through a die

   H. Plastic laminate — Hard, thin, flexible material that is highly resistant to wear and is used as a surface cover for counter tops

   I. Scribe — Tool with a sharp point used to make irregular marks for cutting and fitting a piece of material

   J. Furr down — Enclosed section, which is usually decorated by paint or wallpaper, between ceiling and top of the wall cabinet

   K. Soffit — Underside or lower part of a cornice, arch, or furr down or any such overhanging assembly

   L. Backsplash — Raised portion on back edge of a counter top

   M. Plinth — Face of base cabinet at the toe space

II. Types of cabinets

   A. Custom built on the job

   B. Custom built in a mill or a cabinet shop

   C. Modular or stock units

   (NOTE: Modular or stock units are mass produced in specialized plants that manufacture cabinets. Units may be wooden or metal.)

INFORMATION SHEET

III. Parts of a cabinet (Figure 1)

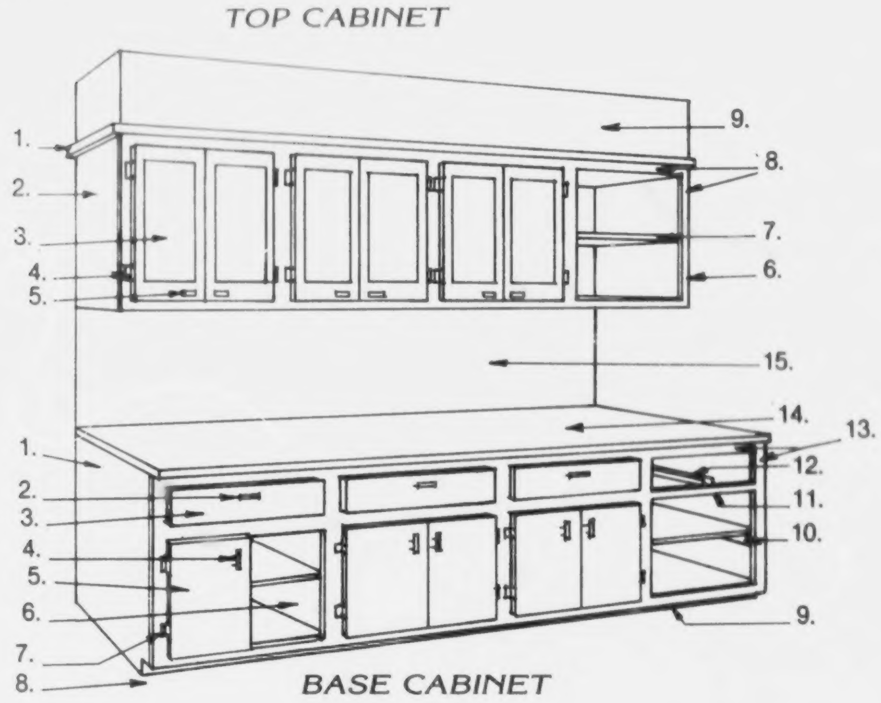
A. Top cabinet

1. Molding
2. End Panel
3. Door
4. Door hinge
5. Door pull
6. Stile
7. Shelf
8. Face frame
9. Furr down

B. Base cabinet

1. End Panel
2. Drawer pull
3. Drawer
4. Door pull
5. Door
6. Bulkhead (interior standard)
7. Door hinge
8. Toe space
9. Plinth
10. Shelf support
11. Rail
12. Drawer guide
13. Face frame
14. Counter top
15. Backsplash

FIGURE 1



TOP CABINET

BASE CABINET

INFORMATION SHEET

IV. Standard sizes of cabinets

A. Base cabinet

1. Height — 36 inches total
2. Depth — 24 inches
3. Depth of counter top = 25 $^{1}/_{2}$ inches (preformed), 24 $^{7}/_{8}$ inches (job built)

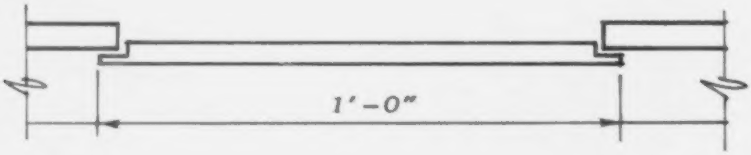
B. Top cabinet

1. Height — 32 inches
2. Depth — 12 inches
3. Vertical distance between counter top and top cabinet — 15 to 18 inches
4. Vertical distance between cooking unit and top cabinet — 24 to 30 inches
5. Vertical distance between sink and top cabinet — 22 inches minimum

V. Types of cabinet-door installations (Figures 2-5)

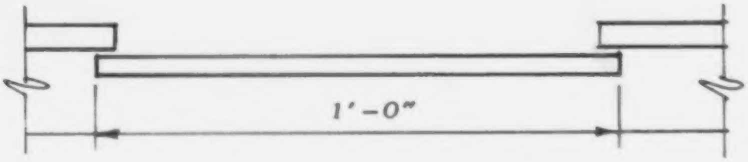
A. Lipped (inset) door

FIGURE 2



B. Surface (overlay) door

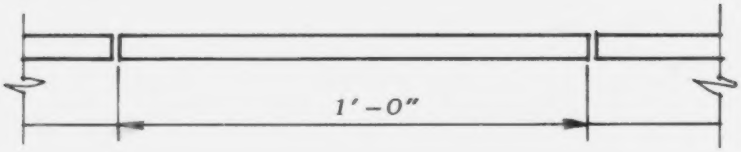
FIGURE 3



INFORMATION SHEET

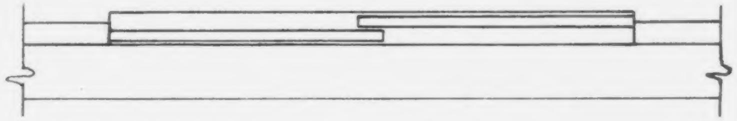
C. Flush door

FIGURE 4



D. Sliding door

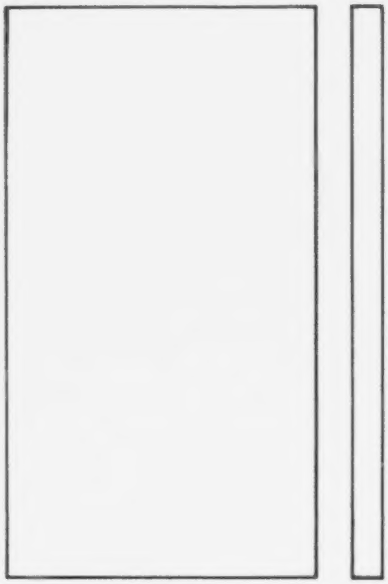
FIGURE 5



VI. Styles of cabinet doors (Figures 6-9)

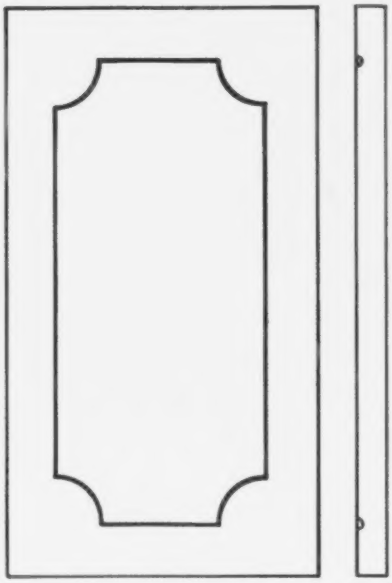
A. Plain

FIGURE 6



B. Embellished

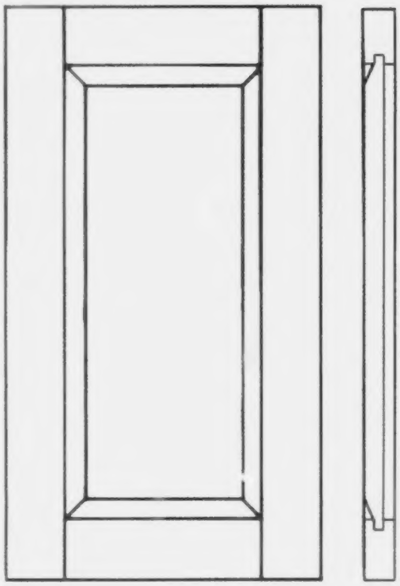
FIGURE 7



INFORMATION SHEET

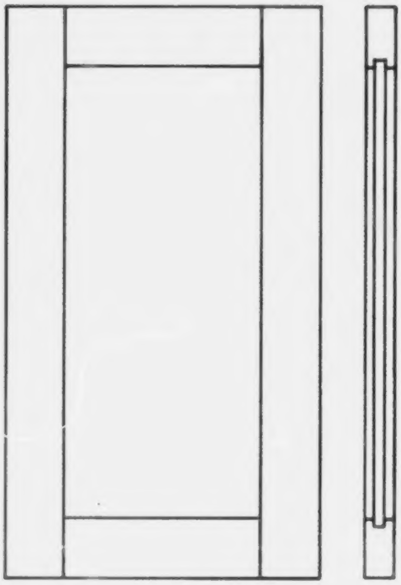
C. Raised panel

FIGURE 8



D. Recessed panel

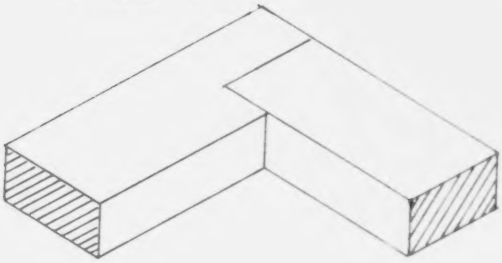
FIGURE 9



VII. Types of joints used in cabinet construction (Figures 10-17)

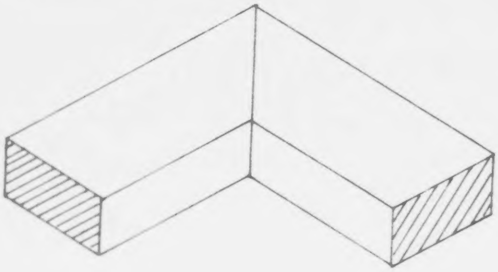
A. Rabbet joint

FIGURE 10



B. Miter joint

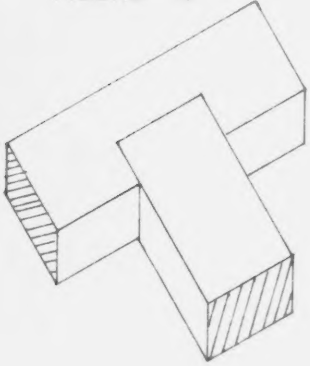
FIGURE 11



INFORMATION SHEET

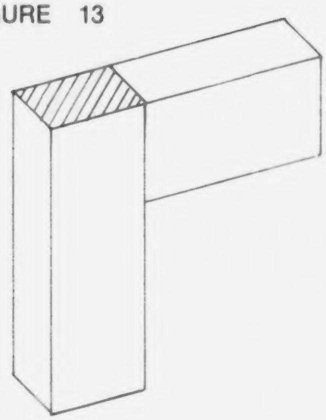
C. Dado joint

FIGURE 12



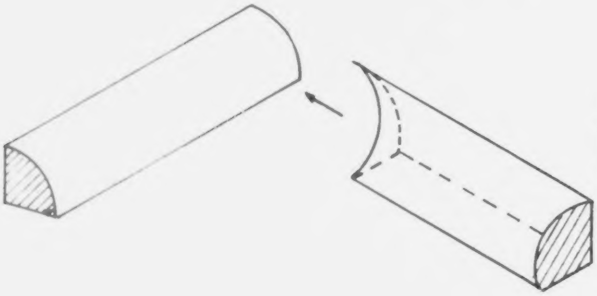
D. Butt joint

FIGURE 13



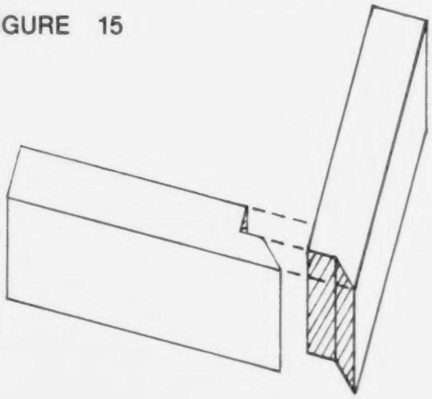
E. Coped joint

FIGURE 14



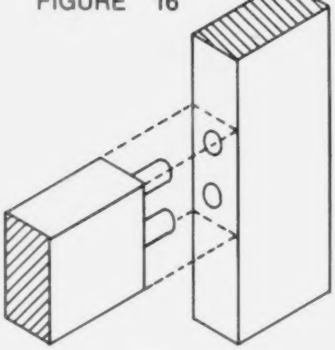
F. Combination miter-rabbet joint

FIGURE 15



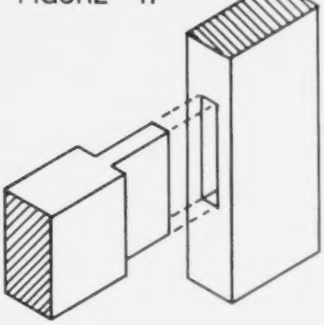
G. Butt joint with dowels

FIGURE 16



H. Mortise and tenon joint

FIGURE 17



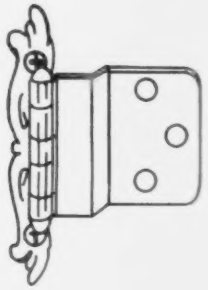
INFORMATION SHEET

VIII. Cabinet hardware

A. Door hinges (Figures 18-24)

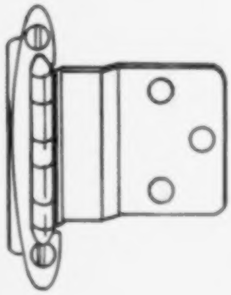
1. Provincial semiconcealed hinge for lipped doors

FIGURE 18



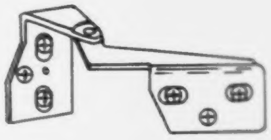
2. Modern semiconcealed hinge for lipped doors

FIGURE 19



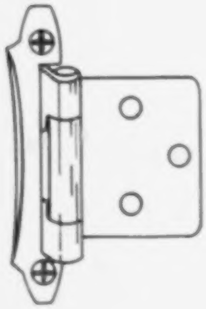
3. Pin or pivot hinge for flush or surface door

FIGURE 20



4. Self-closing semiconcealed hinge for surface door

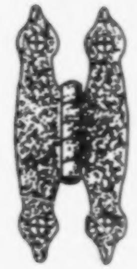
FIGURE 21



INFORMATION SHEET

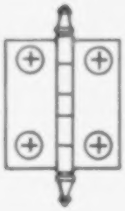
5. H-hinge for flush door

FIGURE 22



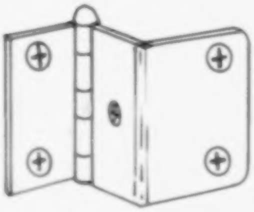
6. Butt hinge for flush door

FIGURE 23



7. Semiconcealed, tightpin hinge for flush door

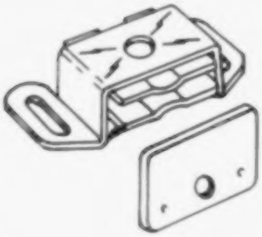
FIGURE 24



B. Door catches (Figures 25-28)

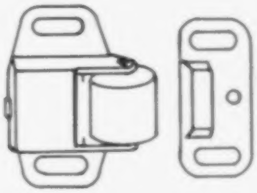
1. Magnetic catch

FIGURE 25



2. Roller catch

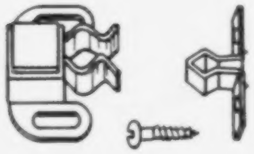
FIGURE 26



INFORMATION SHEET

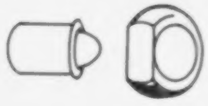
3. Flex (friction) catch

FIGURE 27



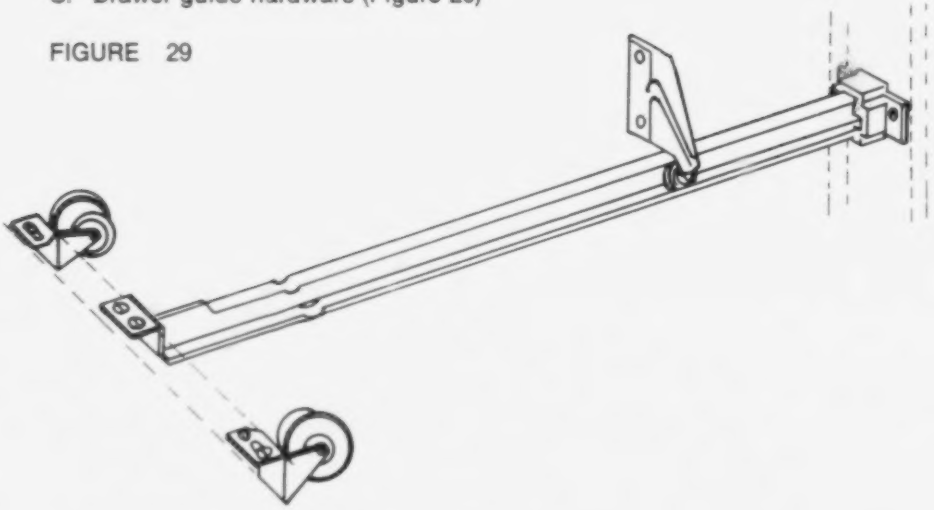
4. Roll-point (bullet) catch

FIGURE 28



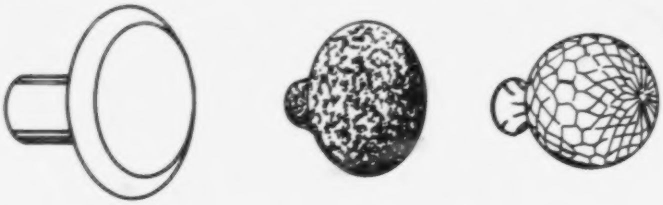
C. Drawer guide hardware (Figure 29)

FIGURE 29



D. Door and drawer knobs (Figure 30)

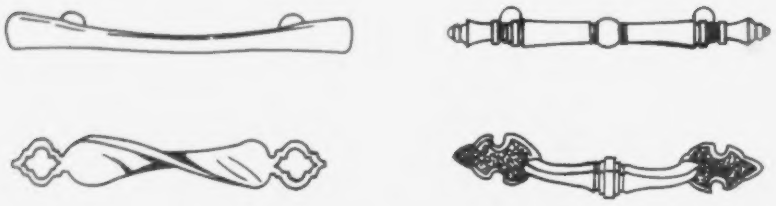
FIGURE 30



INFORMATION SHEET

E. Door and drawer pulls (Figure 31)

FIGURE 31



IX. Types of material used on counter tops

A. Plastic laminate

B. Wood

C. Ceramic tile

D. Quarry tile

E. Cultured marble

X. Types of special built-ins

A. Closet shelves

B. Bookcases

C. Desks

D. Dressing tables

E. Wardrobes

F. Room dividers

CABINETS AND SPECIAL BUILT-INS
UNIT V

JOB SHEET #1 — INSTALL A CUSTOM-BUILT CABINET

I. Tools and equipment

   A. Framing square

   B. Level

   C. Claw hammer

   D. Folding rule or steel tape

   E. Scribe

   F. Block plane

   G. Nail sets

   H. Handsaw

   I. Power handsaw and extension cord

   J. Cabinet units

   K. Shim shingles

   L. Sandpaper

   M. 2×4 scrap material

   N. 2-inch and 2 1/2-inch #8 or #10 screws

   O. Sawhorses, 1 pair

II. Procedures

   (NOTE: Setting of base cabinet and top cabinet sequence is optional.)

   A. Install base cabinet

      1. Set base cabinet near its approximate location

      2. Remove skids, braces, and other packaging

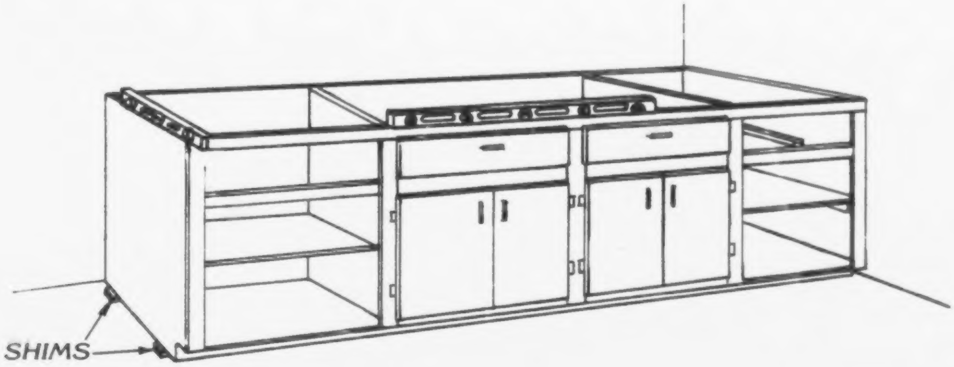
      3. Check to see that there is no wall baseboard or other trim that may interfere with setting the cabinet

      4. Move cabinet against wall in its proper location

JOB SHEET #1

5. Use shingles to shim bottom until top of cabinet is level across the width and depth (Figure 32)

FIGURE 32



6. Adjust scribe to distance between height of the cabinet and the required height

7. Scribe both ends at the bottom and across the front on the plinth

8. Pull cabinet from wall and cut both ends and front to the established lines

9. Check the back of the cabinet and cut if it extends below end cuts

10. Locate wall studs

11. Return cabinet unit to its proper location

12. Drill holes through mounting strips into wall studs

13. Use wood screws to secure cabinet unit to the wall

14. Recheck unit to be sure it is level and plumb

B. Install wall unit

1. Check wall cabinet to be sure it is the same length as the base cabinet

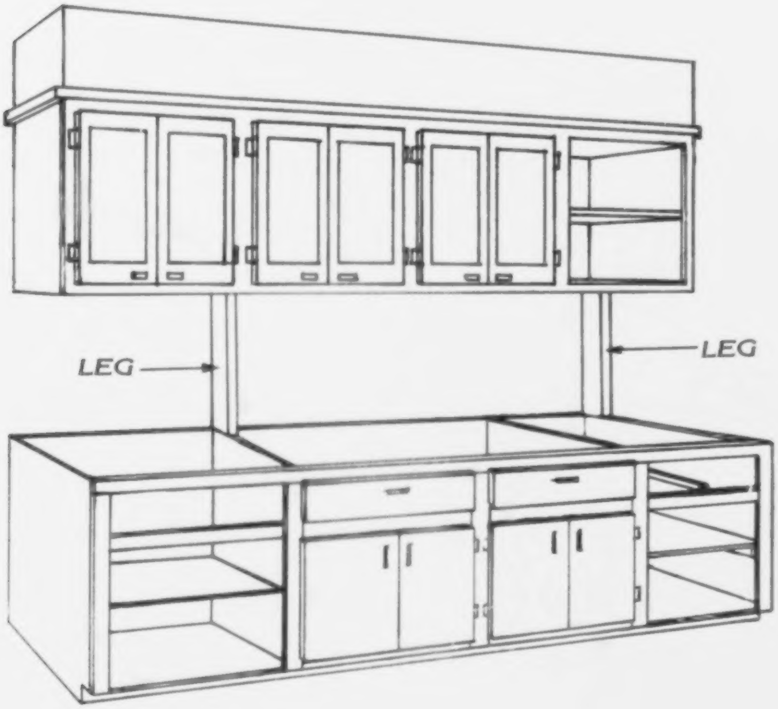
2. Cut two 2×4 legs slightly less than the desired distance between the base cabinet and the bottom of the wall cabinet

3. Set the legs on top of base unit

JOB SHEET #1

4. Set the wall cabinet on top of the legs and shim the cabinet up tight to the soffit (Figure 33)

FIGURE 33



5. Check the cabinet for plumb and level

   (NOTE: If the top cabinet is not plumb and level, it will be necessary to scribe and cut it.)

6. Drill holes through the mounting strips (top and bottom) and into the studs
7. Use wood screws to secure wall cabinet to the wall
8. Remove shims and legs from under the wall cabinet
9. Recheck wall unit to be sure it is plumb, level, and aligned with base cabinet

JOB SHEET #1

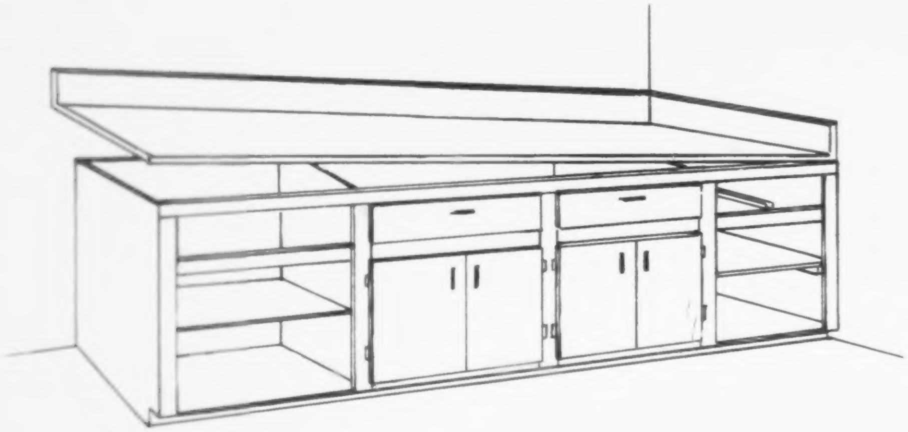
C. Install counter top

1. Check length of counter top to be sure it corresponds with the length of the base cabinet

2. Set counter top on top of the base cabinet (Figure 34)

   (NOTE: Be sure counter top is tight against walls.)

FIGURE 34



3. If backsplash does not fit tight against wall, trim to fit

   a. Scribe the top of the backsplash

   b. Remove counter top from base cabinet and set on a pair of sawhorses

   c. Trim backsplash to the scribed line

   d. Replace counter top to the top of the base cabinet, and check along the wall for proper fit

4. Drill holes up through the frame of the base cabinet into the counter top

> **CAUTION**
>
> Be careful not to drill through the counter top.

5. Secure counter top to base cabinet with proper size wood screws

   (NOTE: Cabinets are set and ready for trim.)

D. Clean area and put away tools and equipment

CABINETS AND SPECIAL BUILT-INS
UNIT V

JOB SHEET #2 — INSTALL SHELVES IN A CLOSET

I. Tools and equipment

A. Tools

1. Framing square
2. Level
3. Claw hammer
4. Folding rule or steel tape
5. Nail sets
6. Scribe
7. Handsaw
8. Power handsaw and extension cord

B. Materials

1. Shelving
2. 1×4 shelf supports, or battens
3. 10d finish nails

II. Procedure

A. Install supports

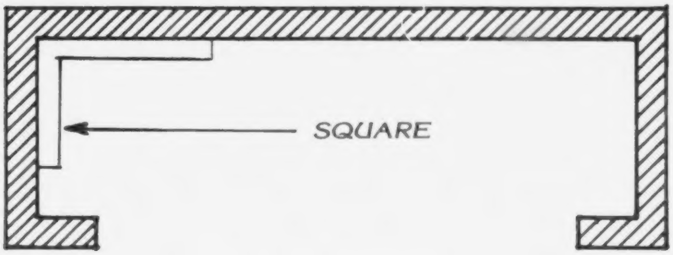
1. Measure up from floor to underside of shelf location
2. Mark height in back corners of closet
3. Mark end walls out from corners the width of shelf, using a level
4. Cut rear support to length
5. Nail rear support to wall with top even with mark on wall, using one nail at each stud
6. Cut and nail side supports to wall
7. Check to be sure supports are level

JOB SHEET #2

B. Install shelf

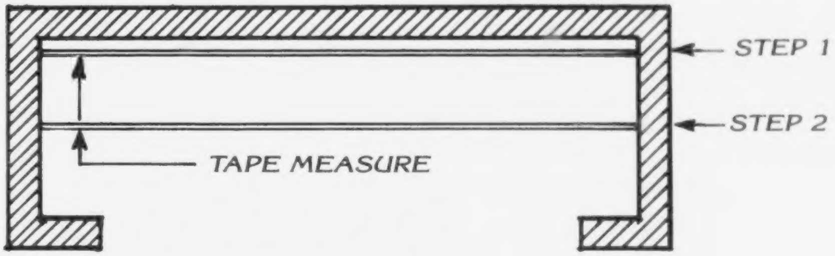
1. Use framing square to check corners for square (Figure 35)

FIGURE 35



2. Check measurements across rear wall (Figure 36, Step 1) and at face of shelf (Figure 36, Step 2)

FIGURE 36



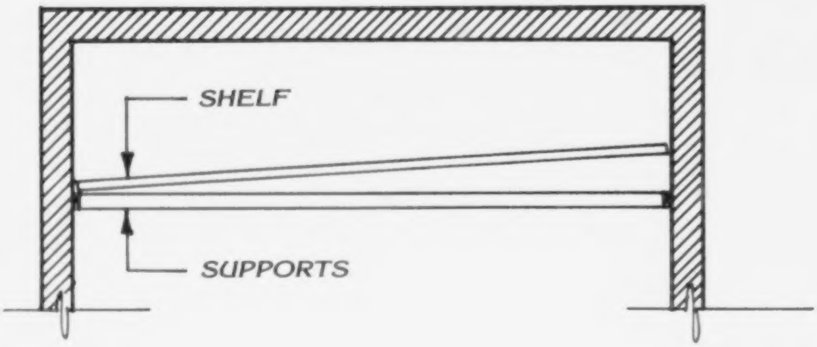
3. Recheck measurements

4. Cut shelf slightly longer than longest measurement

5. Place shelf on supports at left side and lower the right side as far as possible (See Figure 37)

JOB SHEET #2

FIGURE 37



6. Scribe shelf along left side; then remove and cut shelf on this line
7. Recheck measurement across closet at front edge of shelf, and transfer this measurement to top of shelf
8. Replace shelf on supports, this time with shelf resting on right support
9. Set scribe to match mark on shelf, then scribe top of shelf
10. Remove and cut shelf along scribed mark
11. Replace shelf and, if necessary, fasten to supports

C. Repeat steps A and B for each shelf

D. Clean area and put away tools and equipment

CABINETS AND SPECIAL BUILT-INS
UNIT V

TEST

NAME ________________________________ SCORE ______________

1. Match terms associated with cabinet installation and special built-ins to their correct definitions. Write the correct numbers in the blanks.

______a. Cabinet unit attached to wall above base unit

______b. Job-built units pieced together in their permanent location

______c. Underside or lower part of a cornice, arch, or furr down or any such overhanging assembly

______d. Tool with a sharp point used to make irregular marks for cutting and fitting a piece of material

______e. Glazed or unglazed tile made by extrusion process from natural clay or shale

______f. Hard, thin, flexible material that is highly resistant to wear and is used as a surface cover for counter tops

______g. Enclosed section, which is usually decorated by paint or wallpaper, between ceiling and top of the wall cabinet

______h. Process of forming into a particular shape and size by forcing, pressing, or pushing through a die

______i. Preformed or shop-built top of base unit

______j. Nonmetallic mineral tile produced by firing at high temperatures

______k. Cabinet unit that sits on the floor

______l. Raised portion on the back edge of the counter top

______m. Face of base cabinet at the toe space

1. Scribe
2. Ceramic tile
3. Furr down
4. Top or wall cabinet
5. Plinth
6. Backsplash
7. Quarry tile
8. Base cabinet
9. Special built-ins
10. Extrusion
11. Plastic laminate
12. Soffit
13. Counter top

2. Name two types of cabinets.

a. ____

b. ____

TEST

3. Identify parts of the cabinet illustrated below. Write the correct numbers in the blanks.

Top cabinet

______a. Molding

______b. End panel

______c. Furr down

______d. Stile

______e. Door

______f. Face frame

______g. Shelf

______h. Door hinge

______i. Door pull

Base cabinet

______a. Counter top

______b. Drawer

______c. Drawer pull

______d. Toe space

______e. Backsplash

______f. Drawer guide

______g. Door

______h. Door hinge

______i. End Panel

______j. Door pull

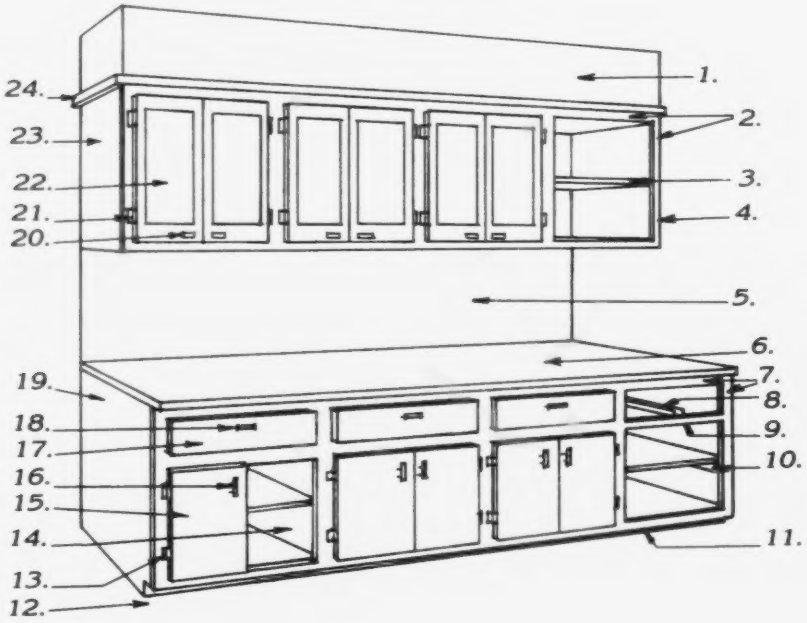
______k. Shelf support

______l. Face frame

______m. Rail

______n. Plinth

______o. Bulkhead (interior standard)


1.
2.
3.
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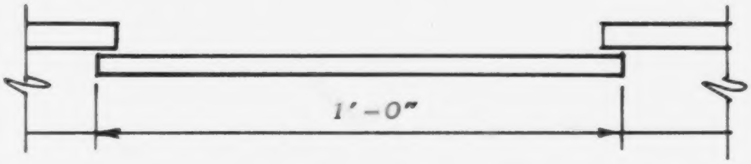
21.
22.
23.
24.

TEST

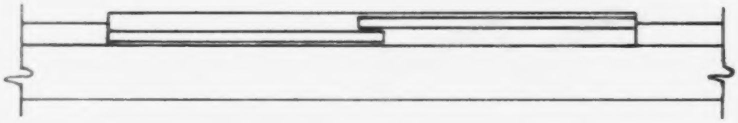
4. Name standard sizes of cabinets.

Base cabinets	**Top cabinet**
a. Height ______________	d. Height ______________
b. Depth ______________	e. Depth ______________
c. Depth of counter top ______________	f. Distance between counter top and top cabinet ______________

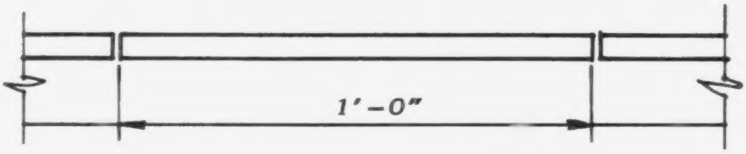
5. Label the types of cabinet-door installations. Write the correct names in the blanks.



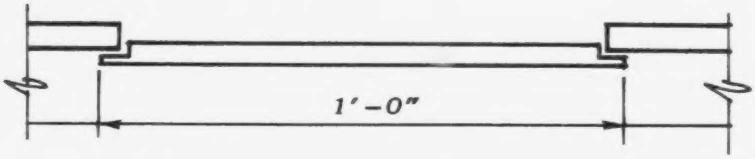
a. ______________________________



b. ______________________________



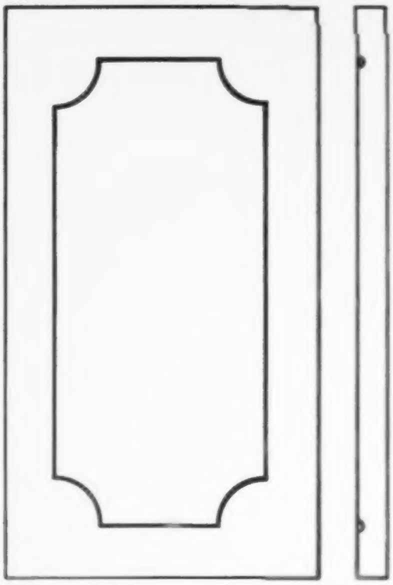
c. ______________________________



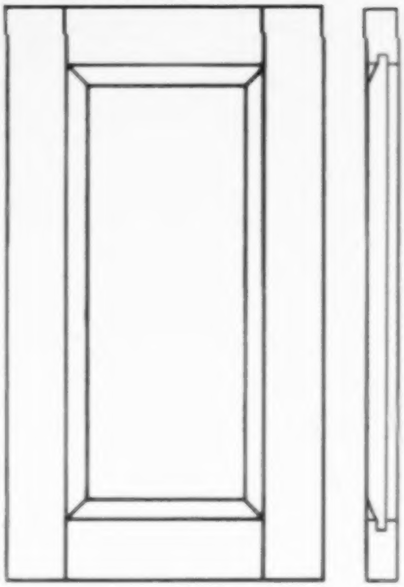
d. ______________________________

TEST

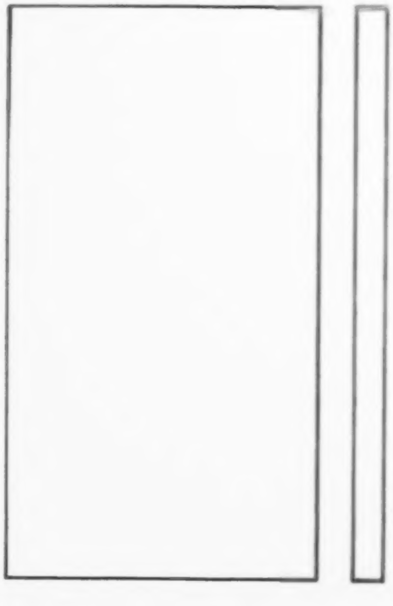
6. Label styles of cabinet doors. Write the correct names in the blanks.



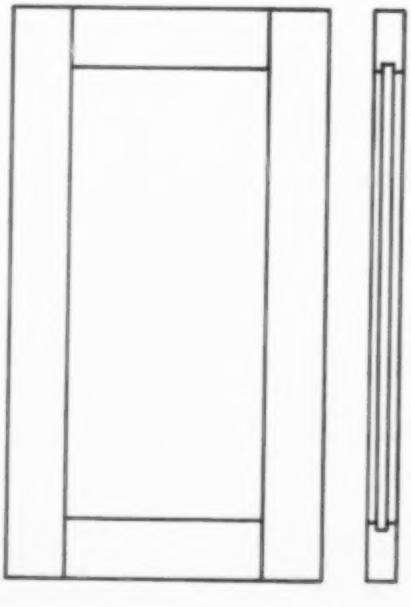
a. ______________________



b. ______________________



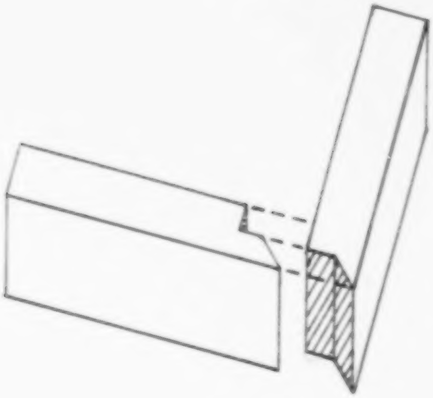
c. ______________________



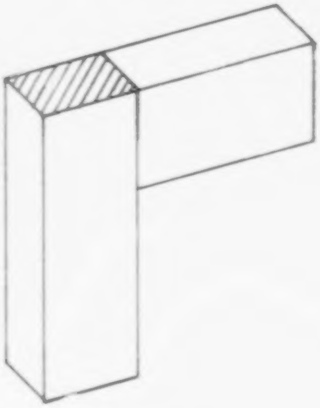
d. ______________________

TEST

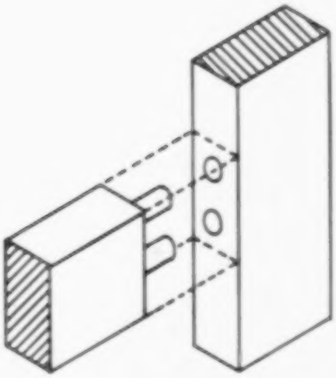
7. Label types of joints used in cabinet construction. Write the correct names in the blanks.



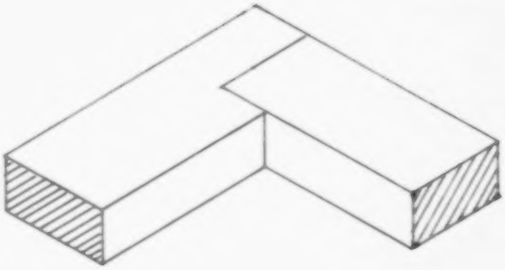
a. ______________________



b. ______________________

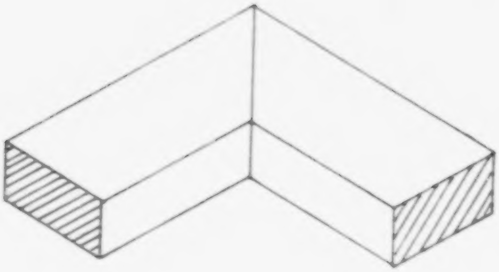


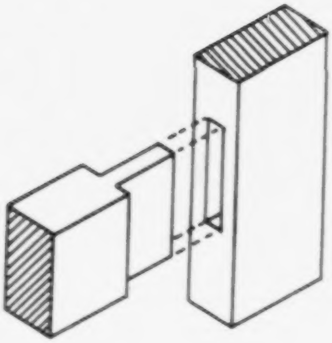
c. ______________________



d. ______________________

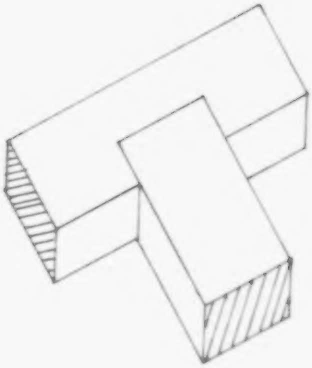
TEST

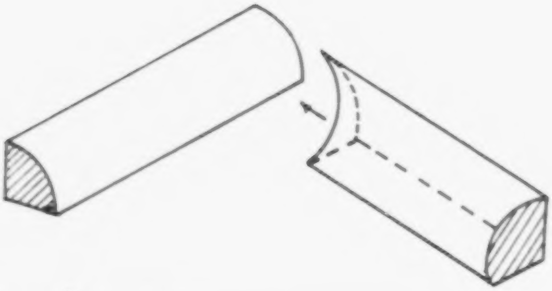




e. ______________________________

f. ______________________________





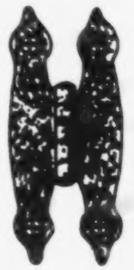
g. ______________________________

h. ______________________________

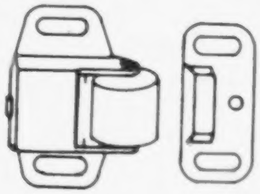
TEST

8. Identify hardware used on cabinets. Write the correct names in the blanks.

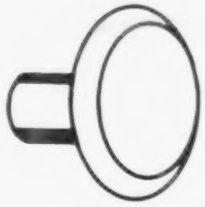
H-hinge for flush door
Flex (friction) catch
Semiconcealed, tightpin hinge for flush door
Magnetic catch
Modern semiconcealed hinge for lipped doors
Pin or pivot hinge for flush or surface door
Butt hinge for flush door
Door and drawer pull
Provincial semiconcealed hinge for lipped doors
Roll-point (bullet) catch
Roller catch
Self-closing semiconcealed hinge for surface door
Drawer guide hardware
Door and drawer knob



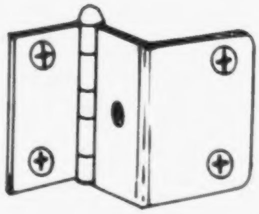
a. ______________________________



b. ______________________________

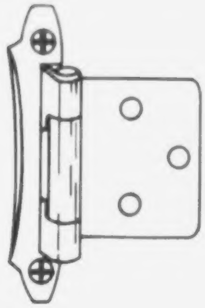


c. ______________________________

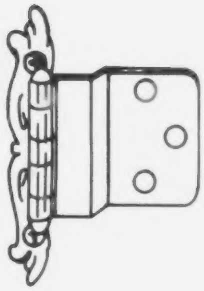


d. ______________________________

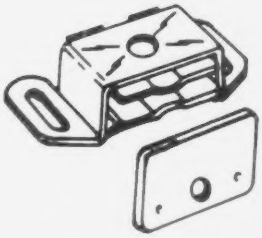
TEST



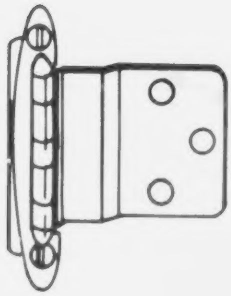
e. ______________________



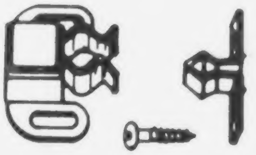
f. ______________________



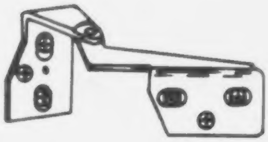
g. ______________________



h. ______________________

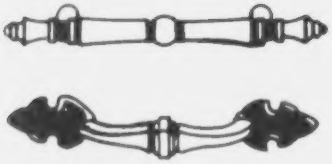


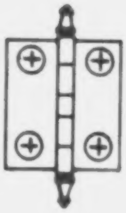
i. ______________________



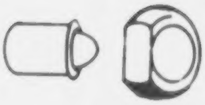
j. ______________________

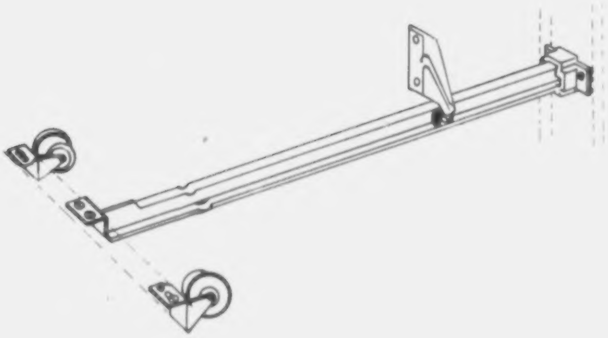
TEST





k. ______________________ l. ______________________





m. ______________________ n. ______________________

9. List three types of materials used on counter tops.

a. ____

b. ____

c. ____

TEST

10. List four types of special built-ins.

    a. ______________________________

    b. ______________________________

    c. ______________________________

    d. ______________________________

(NOTE: Test question 11 lists the job sheets. **They are an important part of the test. If they have not been completed, check with your instructor.**)

11. Demonstrate the ability to

    a. Install a custom-built cabinet.

    b. Install shelves in a closet.

CABINETS AND SPECIAL BUILT-INS
UNIT V

ANSWERS TO TEST

1. a. 4
   b. 9
   c. 12
   d. 1
   e. 7
   f. 11
   g. 3
   h. 10
   i. 13
   j. 2
   k. 8
   l. 6
   m. 5

2. Answer should include any two of the following
   a. Custom built on the job
   b. Custom built in a mill or cabinet shop
   c. Modular or stock units

3. **Top cabinet**

   a. 24
   b. 23
   c. 1
   d. 4
   e. 22
   f. 2
   g. 3
   h. 23
   i. 20

   Base cabinet

   a. 6
   b. 17
   c. 18
   d. 12
   e. 5
   f. 8
   g. 15
   h. 13
   i. 19
   j. 16
   k. 10
   l. 7
   m. 9
   n. 11
   o. 14

4. a. 36 inches
   b. 24 inches
   c. 25 $^{1}/_{2}$ inches (preformed), 24 $^{7}/_{8}$ inches (job built)
   d. 32 inches
   e. 12 inches
   f. 15 to 18 inches

5. a. Surface (overlay) door
   b. Sliding door
   c. Flush door
   d. Lipped (inset) door

ANSWERS TO TEST

6. a. Embellished
   b. Raised panel
   c. Plain
   d. Recessed panel

7. a. Combination miter-rabbet joint
   b. Butt joint
   c. Butt joint with dowels
   d. Rabbet joint
   e. Miter joint
   f. Mortise and tenon joint
   g. Dado joint
   h. Coped joint

8. a. H-hinge for flush door
   b. Roller catch
   c. Doorknob or drawer knob
   d. Semiconcealed, tightpin hinge for flush door
   e. Self-closing semiconcealed hinge for surface door
   f. Provincial semiconcealed hinge for lipped doors
   g. Magnetic catch
   h. Modern semiconcealed hinge for lipped door
   i. Flex (friction) catch
   j. Pin or pivot hinge for flush or surface door
   k. Door or drawer pull
   l. Butt hinge for flush door
   m. Roll-point (bullet) catch
   n. Drawer guide hardware

9. Answer should include any three of the following
   a. Plastic laminate
   b. Wood
   c. Ceramic tile
   d. Quarry tile
   e. Cultured marble

10. Answer should include any four of the following or any others that may be correct; this answer should be evaluated to the satisfaction of the instructor
    a. Closet shelves
    b. Bookcases
    c. Desks
    d. Dressing tables
    e. Wardrobes
    f. Room dividers

11. Performance skills evaluated to the satisfaction of the instructor

FLOOR FINISHES
UNIT VI

UNIT OBJECTIVE

After completing this unit, the student should be able to identify and install various types of finish flooring. The student will show this knowledge by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with floor finishes.
2. Name types of underlayment for finish flooring.
3. Estimate the number of 4′ ×8′ sheets of underlayment needed to floor a room.
4. Name types of finish flooring.
5. List factors to consider when selecting finish flooring.
6. Identify types of hardwood flooring.
7. List types of wood used for hardwood flooring.
8. Name types of resilient flooring.
9. Estimate the number of tiles needed to floor a room.
10. Demonstrate the ability to
    a. Install underlayment.
    b. Install tongue-and-groove hardwood strip flooring.
    c. Install block flooring.
    d. Install resilient tile.

FLOOR FINISHES
UNIT VI

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Supplement #1 — Sizes and Grades of Strip Flooring

   D. Information sheet

   E. Job sheets

      1. Job Sheet #1 — Install Underlayment

      2. Job Sheet #2 — Install Tongue-and-Groove Hardwood Strip Flooring

      3. Job Sheet #3 — Install Block Flooring

      4. Job Sheet #4 — Install Resilient Tile

   F. Test

   G. Answers to test

II. Suggested activities

   A. Review unit and plan presentation.

   B. Obtain materials to supplement unit.

      1. Pictures of various types of floor installations

      2. Samples of underlayment for finish flooring

      3. Containers of mastics and epoxies

      4. House plans for students to use in estimating underlayment and tile needs

      5. Samples of types of finish flooring

      6. Samples of hardwood flooring and photographs of finished hardwood floors

      7. Samples of resilient flooring

SUGGESTED ACTIVITIES

8. Transparencies and competency profiles

   (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

C. Introduce unit.

SUGGESTIONS:

- Have a floor installer talk to the class about this type of work; use a graduate of your program if possible.
- Display pictures of the various types of floor installations to show the variety of finish floorings available; emphasize those installations that are normally done by the carpenters in your area.

D. Provide students with objective sheet; discuss unit and specific objectives.

E. Provide students with information and job sheets.

F. Discuss information and job sheets.

1. Use Information Sheet, Section I to discuss terms associated with finish flooring.

   SUGGESTION:

   - Provide students with examples of materials listed.

2. Use Information Sheet, Section II to discuss types of underlayment for finish flooring.

   SUGGESTIONS:

   - Discuss the distinctions among subfloor, underlayment, and finish floor; also discuss the purpose of each.
   - Show students samples of each type of underlayment; discuss the uses and advantages or disadvantages of each type.
   - Take the class to visit job sites to see underlayment being installed.

3. Use Information Sheet, Section III to discuss estimating the number of 4′ × 8′ sheets of underlayment needed to floor a room.

SUGGESTED ACTIVITIES

SUGGESTIONS:

- Provide students with containers of mastics and epoxies to review coverage statements on labels. Emphasize safety pertaining to mastics and epoxies.
- Emphasize calculating underlayment needs for underlayments generally used in your area.
- Provide students with house plans and allow them to estimate amounts needed for various types of underlayment.
- Demonstrate the procedures in Job Sheet #1.
- Have students complete Job Sheet #1.

4. Use Information Sheet, Sections IV and V to discuss the types of finish flooring and the factors to consider when selecting finish flooring.

SUGGESTIONS:

- Provide students with samples of each type of flooring, stressing those types that are normally installed by carpenters.
- Invite a panel of installers of the various types of flooring to talk to the class about the factors to consider when selecting flooring. The discussion should cover the factors listed in the information sheet and the variables for each, such as local code requirements, differences in costs of materials, differences in labor and material costs for different patterns, etc.

5. Use Information Sheet, Sections VI and VII to discuss types of hardwood flooring and the types of wood used to produce hardwood flooring.

SUGGESTIONS:

- Provide the class with samples of each type of hardwood flooring discussed in the information sheet. Also provide photographs or magazine pictures of what various materials look like when installed.
- Use Supplement #1 and the lumber unit from *Fundamentals of Carpentry* to discuss types of wood used for flooring. Allow students to practice identifying different types of wood, and point out trees in your area used for flooring.
- Ask a hardwood-flooring manufacturer or distributor to discuss hardwood flooring manufacture, use, and installation, or take the class to visit a hardwood-flooring mill if possible.

SUGGESTED ACTIVITIES

- Demonstrate the procedures in Job Sheets #2 and #3.
- Have students complete Job Sheets #2 and #3.

6. Use Information Sheet, Section VIII to discuss types of resilient flooring.

SUGGESTIONS:

- Provide students with samples of each type of resilient flooring discussed in this section of the information sheet. Stress those types of resilient flooring that are commonly installed by carpenters in your area.
- Have an installer of resilient flooring and other finish-flooring installers discuss subfloor and underlayment requirements.
- Take the class to visit construction sites to see resilient flooring being installed.

7. Use Information Sheet, Section IX to discuss estimating the number of tiles needed to floor a room.

SUGGESTIONS:

- Provide students with house plans to allow them to practice estimating.
- Demonstrate the procedures in Job Sheet #4.
- Have students complete Job Sheet #4.

G. Give test.

H. Critique test and discuss in class.

I. Reteach if necessary.

J. Complete appropriate sections of competency profiles.

III. Unit references

A. Burke, Arthur E., J. Ralph Dalzell, and Gilbert Townsend. *Architectural and Building Trades Dictionary.* Chicago, Illinois: American Technical Society, 1955.

B. Durbahn, Walter E., and Elmer W. Soundberg. *Fundamentals of Carpentry*, 3rd ed. Chicago, Illinois: American Technical Society, 1963.

C. Feirer, John L. *Woodworking for Industry.* Peoria, Illinois: Charles Bennett Company, Inc., 1971.

SUGGESTED ACTIVITIES

D. Gronemon, Chris H., and Everett R. Galzener. *Technical Woodworking*. St. Louis, Missouri: McGraw-Hill Book Company, 1966.

E. Lewis, Gaspar J. *Carpentry*. Albany, New York: Delmar Publishers Inc., 1984.

F. Penner, Wayman R. *Residential Carpentry*. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1973.

G. Smith, Ronald C. *Principles and Practices of Light Construction*. Englewood Cliffs, New Jersey: Prentice Hall Inc., 1970.

H. Wagner, Willis H. *Modern Carpentry*. South Holland, Illinois: Goodheart-Willcox Company, Inc., 1976.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — SIZES AND GRADES OF STRIP FLOORING

Species	Grain Orientation	Size		First Grade	Second Grade	Third Grade
		Thickness (in inches)	Width (in inches)			
			Softwood			
Douglas fir and hemlock	Edge grain	25/32	2 3/8 – 5 3/16	B and better	C	D
	Flat grain	25/32	2 3/8 – 5 3/16	C and better	D	—
Southern pine	Edge grain and Flat grain	5/16 – 1 5/16	1 3/4-5 7/16	B and better	C and better	D (and No. 2)
			Hardwood			
Oak	Edge grain	25/32	1 1/2 – 3 1/4	Clear	Select	—
	Flat grain	3/8	1 1/2, 2	Clear	Select	No. 1 common
		1/2	1 1/2, 2			
Beech, birch, maple, and pecan*		25/32	1 1/2 – 3 1/4	First grade	Second grade	—
		3/8	1 1/2, 2			
		1/2	1 1/2, 2			

*Special grades are available in which uniformity of color is a requirement.

FLOOR FINISHES
UNIT VI

INFORMATION SHEET

I. Terms and definitions associated with floor finishes

A. Underlayment — Material applied over subfloor to provide smooth surface for finish floor

B. Resilient flooring — Finish flooring that conforms to surface upon which it is laid

EXAMPLES: Vinyl flooring, asphalt tile

C. Adhesive — Glue, cement, mastic, paste, or any substance capable of holding materials together by surface attachment

D. Mastic — Adhesive used to attach finish flooring to subfloor

E. Epoxy (seamless flooring) — Plasticlike substance that is applied as a liquid and hardens to a durable finish; used both as underlayment and finish flooring

F. Hardboard — Material made of wood fiber formed into panels

II. Types of underlayment for finish flooring

A. Plywood

B. Particle board

C. Hardboard

D. Wafer board

E. Mastic

F. Epoxy

III. Estimating the number of 4′ × 8′ sheets of underlayment needed to floor a room

(NOTE: Most underlayment comes in 4′ × 8′ sheets, and the procedure below describes how to estimate underlayment material needs using 4′ × 8′ sheets. For epoxies and similar products, refer to the manufacturer's instructions for coverage.)

A. Measure or check plans to find length and width of room

B. Multiply length times width to find square footage to be covered with underlayment

EXAMPLE: If a room is 16 feet wide and 30 feet long, then

16′ × 30′ = 480 sq ft to be covered with underlayment

INFORMATION SHEET

C. Divide square footage by 32 and round up to the next whole number, if necessary, to find the number of 4′ × 8′ sheets needed

(NOTE: There are 32 square feet in one 4′ × 8′ sheet.)

EXAMPLE: If there are 480 square feet to be covered with underlayment, then

480 sq ft ÷ 32 sq ft = 15 sheets needed

IV. Types of finish flooring

A. Hardwood

B. Resilient tile

C. Resilient sheet

D. Clay tile

E. Epoxy

F. Carpeting

G. Concrete

V. Factors to consider when selecting finish flooring

A. Types of flooring materials that are available

B. Type of underlayment or base that has been installed

C. Application method that will be used

D. Material and installation cost limitations

E. Conditions under which installation is to be made

(NOTE: Follow manufacturer's recommendations and instructions when applying flooring; also use adhesive that has been recommended and follow instructions for that particular adhesive.)

VI. Types of hardwood flooring (Figures 1-8)

(NOTE: Most hardwood flooring can be purchased either prefinished or unfinished.)

A. Strip flooring

(NOTE: Strip flooring comes in widths of 1½ to 3¼ inches, in thicknesses of ⅜ to ¾ inch, and in various lengths, usually with ends and edges matched. Strip flooring may be purchased with square edges, but the tongue-and-groove type is used more extensively. See Figure 1.)

INFORMATION SHEET

FIGURE 1

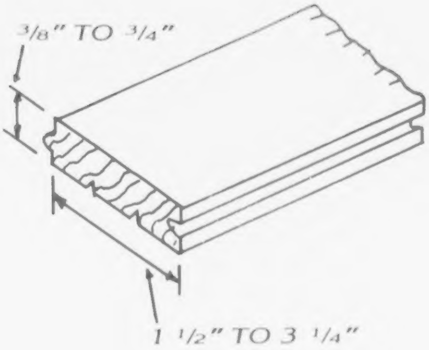
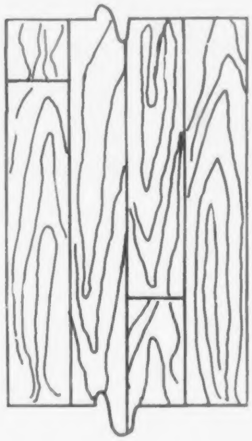


FIGURE 2: Top view



B. Plank flooring

(NOTE: Plank flooring is similar to strip flooring except that it comes in random widths of 3 to 8 inches. This flooring may have predrilled securing holes that are later filled with wood plugs. See Figure 3.)

FIGURE 3

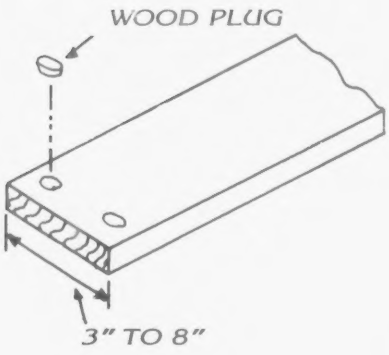
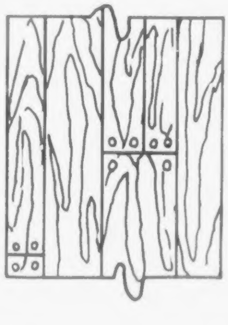


FIGURE 4: Top view



C. Parquet flooring

(NOTE: Parquet flooring comes in short pieces that are 6¾ to 13½ inches long. It is end- and edge-matched and may be laid in various patterns. See Figure 5.)

INFORMATION SHEET

FIGURE 5

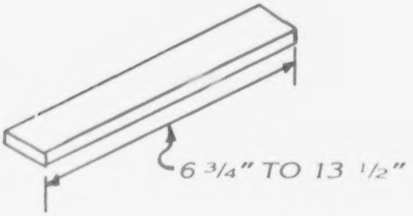
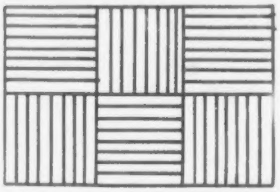


FIGURE 6: Top view



D. Block flooring

(NOTE: Block flooring comes in squares of from 4" × 4" to 12" × 12". The blocks may be solid lumber, laminated sheets, or parquetlike slats held together with splines.)

FIGURE 7: Unit block

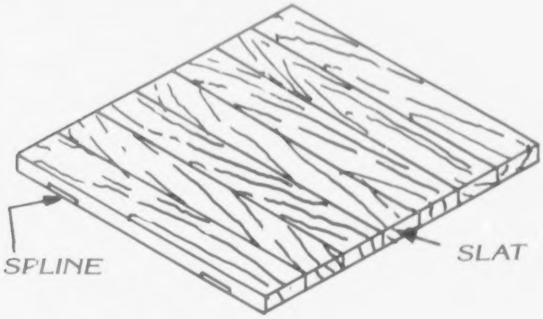
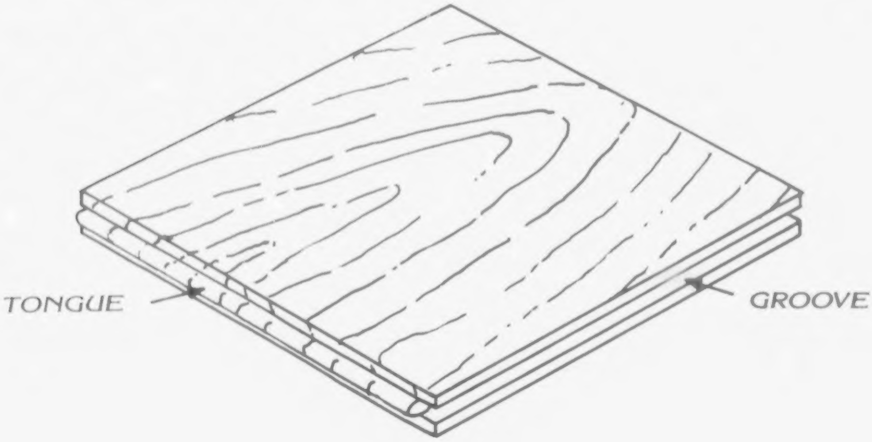

SPLINE
SLAT

FIGURE 8: Laminated block


TONGUE
GROOVE

INFORMATION SHEET

VII. Types of wood used for hardwood flooring

(NOTE: The woods listed below are the most commonly used woods; however, some soft woods such as Douglas fir, hemlock, and southern pine are used for less-expensive finish flooring.)

A. Beech
B. Birch
C. Hard maple
D. Pecan
E. Red oak
F. White oak

VIII. Types of resilient flooring

(NOTE: Before attempting to lay resilient flooring, be sure underlayment is fastened securely, fasteners are flush with floor, surfaces are smooth, and floor is clean.)

A. Asphalt
B. Cork
C. Rubber
D. Vinyl
E. Vinyl asbestos

IX. Estimating the number of tiles needed to floor a room

A. Check plans or measure to find length and width of room

B. Round dimensions up to next whole foot, if necessary

EXAMPLE: If the room's actual measurements are 13′ – 8″ × 29′ – 4″, then use 14′ × 30′ when you are estimating.

C. Multiply length times width to find square footage to be tiled

EXAMPLE: If a room's measurements are 14 feet × 30 feet, then

14′ × 30′ = 420 sq ft to be tiled

D. Multiply square footage to be tiled by number of tiles needed to cover 1 square foot to find number of tiles needed; round up to next whole number if necessary

(NOTE: For 12″ × 12″ tiles, one tile is needed to cover 1 square foot of area. For 9″ × 9″ tiles, 1.33 tiles are needed to cover 1 square foot.)

EXAMPLE: If there are 420 square feet to be tiled and 9″ × 9″ tiles will be used, then

420 sq ft × 1.33 = 558.60 or 559 tiles needed

FLOOR FINISHES
UNIT VI

JOB SHEET #1 — INSTALL UNDERLAYMENT

I. Tools and equipment

- A. Folding rule or steel tape
- B. Framing square
- C. Straightedge
- D. Claw hammer
- E. Chalk line
- F. Utility knife
- G. Pointing or margin trowel
- H. Power handsaw and extension cord
- I. Power fastener, fasteners, and manufacturer's instructions
- J. One pair of saw horses
- K. 15-pound felt
- L. ¼″ × 4′ × 8′ hardboard panels for underlayment
- M. Ring-shank, grooved, or cement-coated nails
- N. Hard putty or wood filler and manufacturer's instructions
- O. Power sander and sanding belts

II. Procedure

(NOTE: At least twenty-four hours prior to installation, lean the panels in the room where they will be used. This will condition the panels to the room's atmosphere and minimize expansion and contraction of the panels.)

- A. Clean work surface
- B. Mark centers of all floor joists on walls

JOB SHEET #1

C. Apply 15-pound felt, lapping head and side joints at least 4 inches and using only enough fasteners to hold felt in place

D. Snap lines along centers of floor joists

E. Install first underlayment panel

   1. Position panel in a corner at right angle to floor joists with 1/8-inch allowance between edges of panel and wall

   2. Secure panel, placing approved fasteners 3/8 inch in from edges and approximately 6 inches on center over entire surface of panel

F. Install remaining panels

(NOTE: Be sure to stagger the head joints of the panels and avoid aligning the joints in the underlayment with the joints in the subfloor.)

   1. Measure, cut, and fit panels to size, allowing approximately 1/16 inch between panels on all sides

   2. Secure panels, placing fasteners 3/8 inch in from edges and approximately 6 inches on center over surface of each panel

G. Fill all joints and cracks with putty or wood filler and let dry for recommended time

H. Sand floor smooth

I. Clean up area and put away tools and equipment

FLOOR FINISHES
UNIT VI

JOB SHEET #2 — INSTALL TONGUE-AND-GROOVE HARDWOOD STRIP FLOORING

I. Tools and equipment

- A. Folding rule or steel tape
- B. Try square
- C. Claw hammer
- D. Nail set
- E. Utility knife
- F. Chalk line
- G. Power nailer, nails, and manufacturer's instructions
- H. Power handsaw and extension cord
- I. Table saw or radial-arm saw
- J. 15-pound felt
- K. Tongue-and-groove hardwood strip flooring
- L. Flooring nails
- M. One pair of saw horses

II. Procedure

(NOTE: At least twenty-four hours prior to installation, loosely stack flooring in room where it will be used. This will condition the flooring to the room's atmosphere and minimize the expansion and contraction of the flooring.)

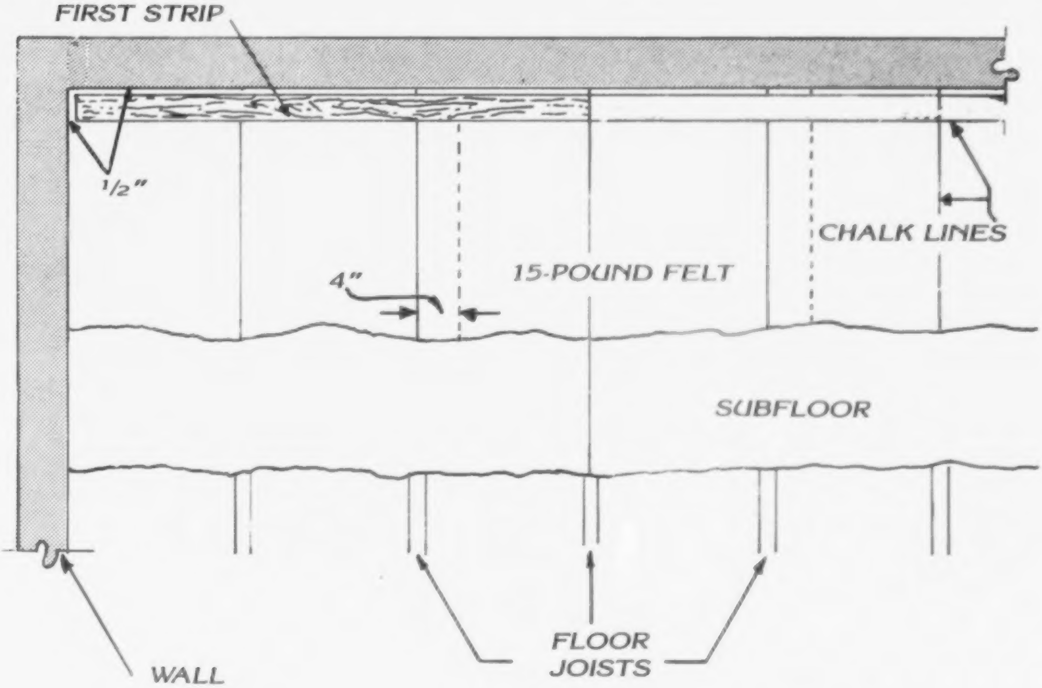
- A. Clean work surface
- B. Mark centers of all floor joists on walls
- C. Apply 15-pound felt, lapping head and side joints at least 4 inches and using only enough fasteners to hold felt in place (See Figure 9)
- D. Snap lines along centers of floor joists
- E. Positioning a flooring strip at right angle to floor joists, measure over from wall the width of the flooring strip plus 1/2-inch clearance; remove strip and snap a line at this point

JOB SHEET #2

F. Install first flooring strip

1. Reposition strip at right angle to floor joists with grooved edge toward wall, other edge along chalk line, and 1/2-inch clearance between end of strip and wall (Figure 9)

FIGURE 9


FIRST STRIP
1/2"
CHALK LINES
4"
15-POUND FELT
SUBFLOOR
WALL
FLOOR JOISTS

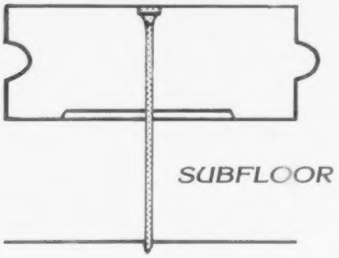
2. Determine nailing requirements by using Table 1, and then face-nail first strip (See Figure 10)

TABLE 1: Length of Nail and Nail Spacing for Flooring

Flooring (in inches)	Nail Length (in inches)	Nail Spacing (in inches)
3/8	1 1/4	8
1/2	1 1/2	10
3/4	2 1/4	12 to 16
1	3	16

JOB SHEET #2

FIGURE 10: Face-nailing



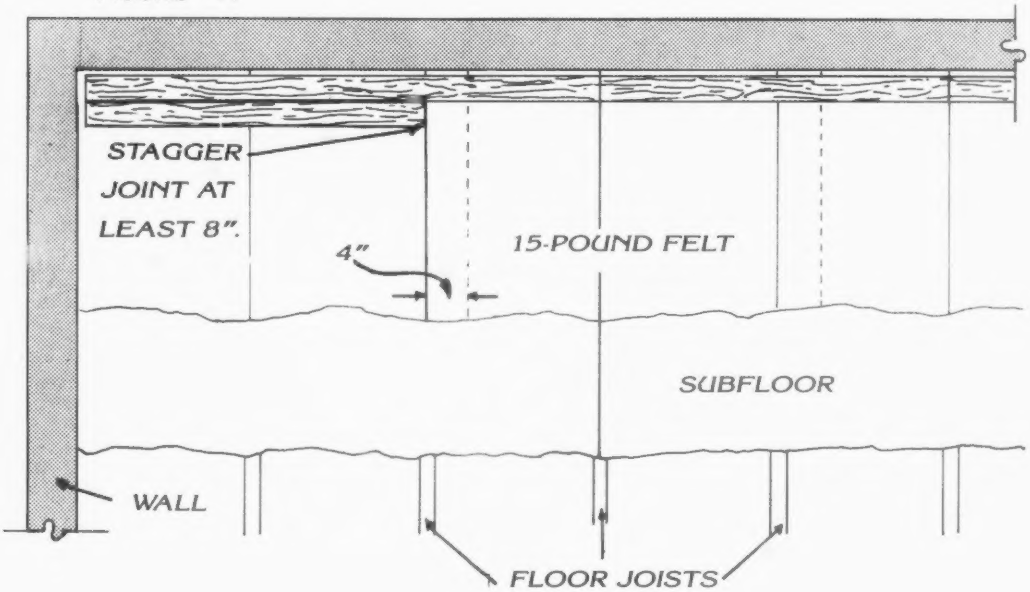
G. Install remaining strips in first row

1. Lay each full strip with grooved edge toward wall and other edge along chalk line
2. Face-nail, being sure each strip is snug against the one behind it and that end joints are tight and square
3. Measure space required for last piece of flooring, allowing 1/2-inch clearance between end of piece and wall
4. Cut last piece to measured length and face-nail in position

H. Install first strip in second row

1. Lay out first strip with first joint staggered at least 8 inches from first joint in adjacent row (Figure 11)

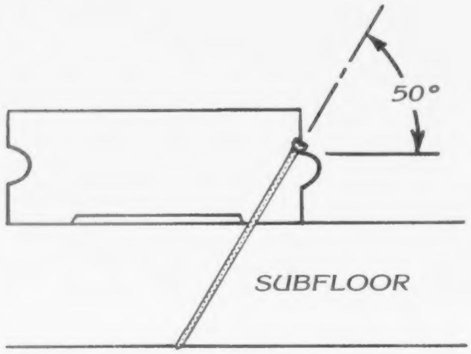
FIGURE 11


STAGGER JOINT AT LEAST 8".
4"
15-POUND FELT
SUBFLOOR
WALL
FLOOR JOISTS

JOB SHEET #2

2. Blind-nail first strip in place by slanting nails at a 50-degree angle (Figure 12)

FIGURE 12: Blind-nailing



I. Install remaining strips in second row

   1. Lay out 3 or 4 feet of flooring, staggering joints at least 8 inches from joints in adjacent row
   2. Blind-nail 3 or 4 feet of flooring, being sure each strip is snug against the one behind it and that end joints are tight and square
   3. Check to see that strips are running parallel; adjust as necessary
   4. Continue installing strips, following procedures in steps 1 through 3
   5. Measure space required for last piece of flooring, allowing ½-inch clearance between end of piece and wall
   6. Cut last piece to measured length and blind-nail in position

J. Continue laying out, blind-nailing, and checking strips until all but last row of flooring has been installed

K. Install last row of flooring

   1. Measure to determine required width of strips in last row, allowing ½-inch clearance between wall and flooring
   2. Rip strips to measured width if necessary
   3. Lay full strips, being sure each strip is snug against the one behind it and that end joints are tight and square; face-nail strips into position

JOB SHEET #2

    4. Measure space required for last piece of flooring, allowing $\frac{1}{2}$-inch clearance between end of piece and wall
    5. Cut last piece to measured length and face-nail into position

L. Check installation for accuracy and proper workmanship

M. Set face nails and fill nailholes

N. Clean area and put away tools and equipment

FLOOR FINISHES
UNIT VI

JOB SHEET #3 — INSTALL BLOCK FLOORING

I. Tools and equipment

- A. Folding rule or steel tape
- B. Chalk line
- C. Notched trowel
- D. Flooring blocks and manufacturer's instructions
- E. Mastic and manufacturer's instructions

II. Procedure

(NOTE: There are several variations in the installation procedures for block flooring. Detailed installation instructions are usually furnished with the flooring. Follow the manufacturer's instructions if different from the procedure given in this job sheet.)

A. Clean work surface

B. Determine starting point

(NOTE: Some carpenters prefer to lay out actual flooring blocks when trying to determine the starting point.)

1. Beginning at main entrance to room, measure distance to opposite wall

   (NOTE: Measure straight across the room to the opposite wall. If the opposite wall contains a doorway without a threshold, add one-half the thickness of the opening to the distance obtained, because flooring is normally laid to the midpoint of a doorway. If a threshold is used in the doorway, measure to the inside edge of the threshold.)

2. Divide distance determined in step 1 by length of one flooring block

   EXAMPLE: If the distance to be floored in a room is 13′ – 10″ and 9″ × 9″ blocks will be used, then

   13′-10″ = 166″
   166″ ÷ 9″ = 18 blocks, with a remainder of 4″

3. Divide any remainder found in step #2 by 2

   EXAMPLE: If there is a remainder of 4; then

   4″ ÷ 2 = 2″

4. If amount determined in step 3 is less than one-half length of one block, add one-half length of one block to determine the actual width of border pieces

   EXAMPLES: Since 2 inches is less than 4 1/2 inches, half the length of the 9-inch block, add one-half the length of the flooring, or

   2" + 4 1/2" = 6 1/2" width of border pieces

5. Measure out from doorway a distance equal to width of border piece plus four whole blocks

   EXAMPLE: If the border piece is 6 1/2 inches and each block is 9" × 9", then

   6 1/2" + 4 (9) =
   6 1/2" + 36" = 42 1/2"

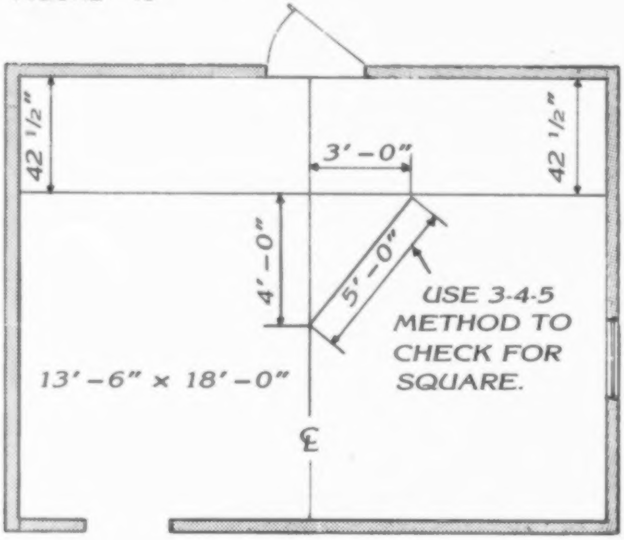
6. At point determined in step 5, snap a chalk line parallel to wall containing main entrance

7. Repeat steps 1 through 4 to determine the number of whole blocks and width of border pieces between other two walls of room

8. Snap a chalk line square to the first line at a point even with the edge of a block midway between the end walls; use the 3-4-5 method to ensure that the lines are square (Figure 13)

   (NOTE: If there is an even number of whole blocks between the two walls, the line will be half way between the two walls. If there is an odd number of whole blocks between the two walls, then the second line will be along the edge of the middle, or one-half the width of a block from the center. See Figure 13.)

FIGURE 13



JOB SHEET #3

C. Use notched trowel to spread mastic in area at one corner of intersecting lines, being careful not to destroy chalk lines

(NOTE: Do not spread more mastic than you can use before the mastic sets. See manufacturer's instructions.)

D. Allow mastic to set up in accordance with manufacturer's instructions

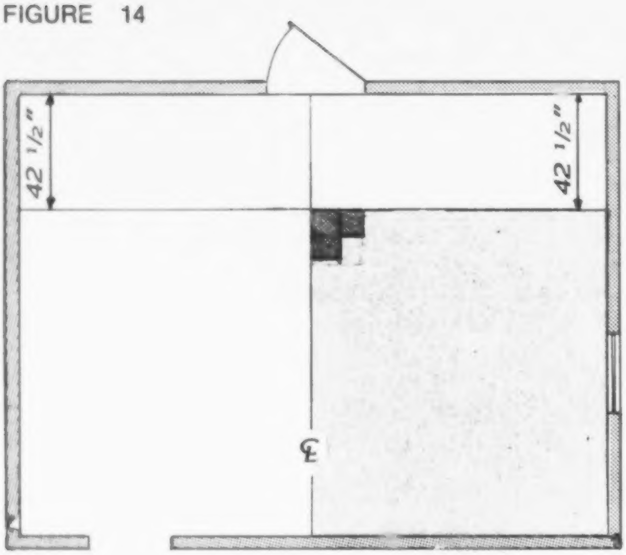
E. Place first block in one of the right angles formed where the two lines intersect (See Figure 14)

(NOTE: Be sure that tile is set even with the chalk line on the two sides.)

F. Position second block for correct pattern, placing this block against first block and even with chalk line (Figure 14)

(NOTE: Flooring blocks are often laid so that wood grains in adjoining block are at right angles to each other)

FIGURE 14



G. Continue laying blocks, working from chalk lines toward walls

H. Spread mastic and lay blocks to complete job, trimming blocks as necessary

(NOTE: Cut blocks away from work area to avoid getting sawdust on mastic.)

I. As you go, wipe off any mastic that may have smeared on blocks

J. Clean up area and put away tools and equipment

FLOOR FINISHES
UNIT VI

JOB SHEET #4 — INSTALL RESILIENT TILE

I. Tools and equipment

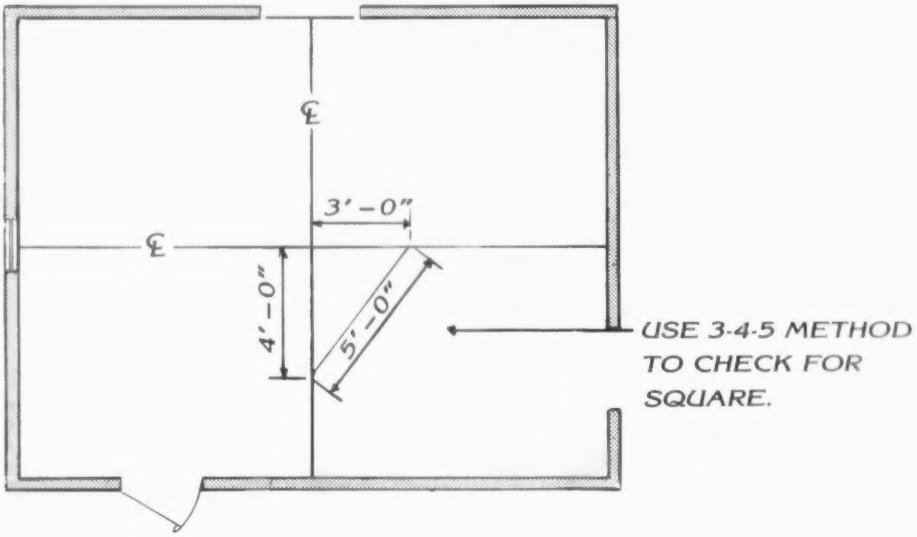
- A. Folding rule or steel tape
- B. Chalk line
- C. Notched trowel
- D. Linoleum knife
- E. Tile cutter
- F. Propane torch
- G. Resilient tile
- H. Adhesive and manufacturer's instructions

II. Procedure

- A. Clean work surface
- B. Lay out and snap chalk lines for starting point
  1. Locate center of end walls and mark

     (NOTE: Disregard any breaks or irregularities in the room's contour.)
  2. Snap a chalk line between end-wall center-line marks (See Figure 15)
  3. Locate center line of sidewalls
  4. Snap a chalk line between sidewall center-line marks (See Figure 15)
  5. Use 3-4-5 method to see that lines are square (Figure 15)

FIGURE 15

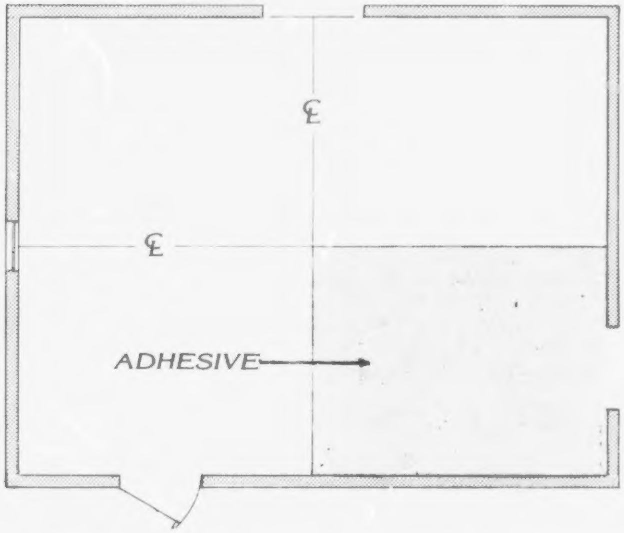


JOB SHEET #4

C. Apply even coat of adhesive over one-fourth of floor area; spread adhesive even with chalk lines, but do not cover them (Figure 16)

(NOTE: Follow adhesive manufacturer's recommendations and instructions.)

FIGURE 16



D. Allow adhesive to dry in accordance with manufacturer's instructions

E. Lay tile in first one-fourth of floor area

1. Stack tiles from different boxes together

   (NOTE: Mixing tiles prevents differences in colors of production lots from being obvious on completed floor.)

2. Place first tile in corner formed by chalk lines, aligning two sides even with chalk lines

   (NOTE: Be careful when laying tile not to slide it into position; this may cause the adhesive to ooze up between the joints.)

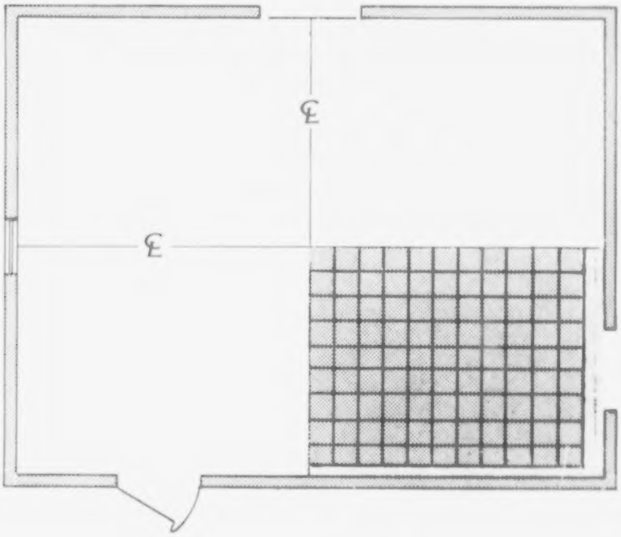
3. Position second tile tight against first tile and even with chalk line; also make sure pattern of tile runs correctly

   (NOTE: Many patterns of resilient tile are laid so that grains and colorations are at right angles to each other, and some tiles have continuous patterns. Position tiles to allow for the continuation of the pattern.)

JOB SHEET #4

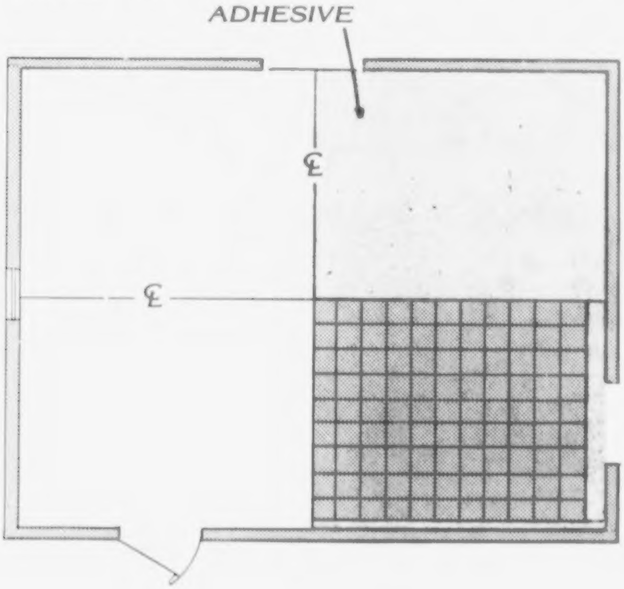
4. Work from chalk lines toward wall, laying full tiles until all but border area is covered (Figure 17)

FIGURE 17



F. Apply even coat of adhesive over second one-fourth of floor area (Figure 18)

FIGURE 18



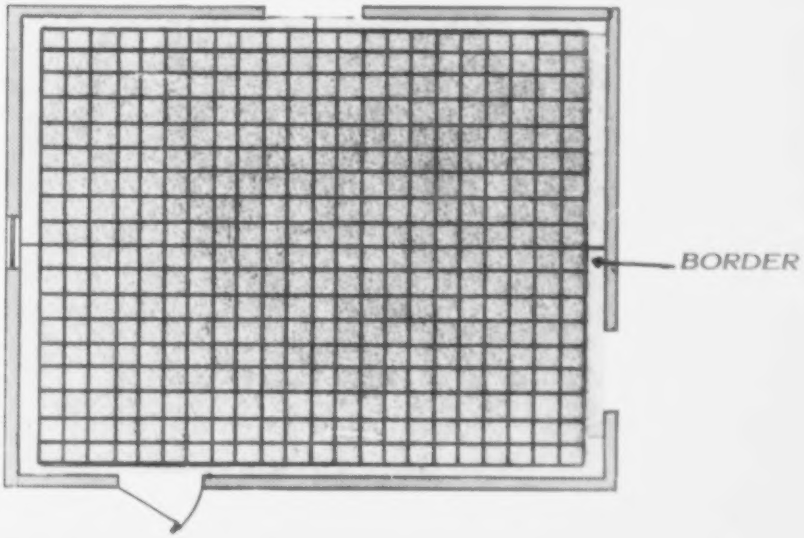
JOB SHEET #4

G. Allow adhesive to dry in accordance with manufacturer's instructions

H. Lay tile, following procedures in steps E-1 through E-4

I. Spread adhesive and lay tile in third and fourth one-fourths of floor area until all but border area is covered (Figure 19)

FIGURE 19

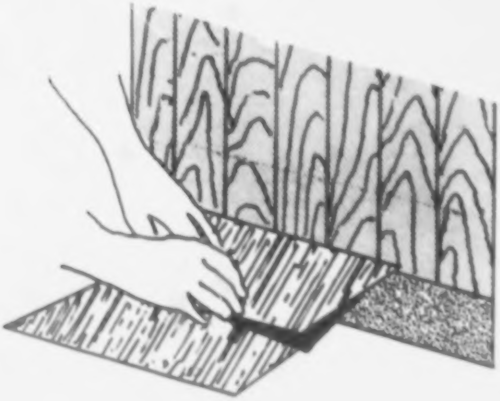


J. Check installation for proper positioning and fit

K. Mark and cut first border tile to proper width

1. Place a loose tile squarely over one corner tile
2. Place another tile against wall and overlapping loose tile (Figure 20)

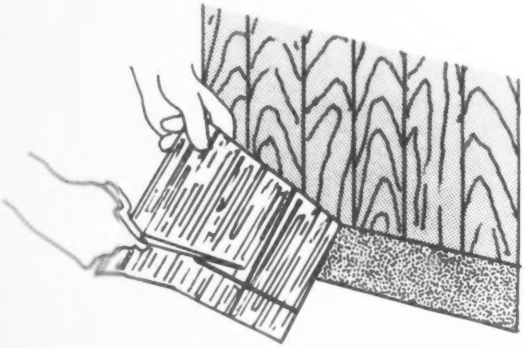
FIGURE 20



JOB SHEET #4

3. Mark face of bottom loose tile where the tile above overlaps it
4. Move top loose tile so that it is against the other corner wall and overlapping bottom loose tile
5. Mark face of bottom loose tile where the tile above overlaps it
6. Cut tile on marked lines (Figure 21)

FIGURE 21



7. Lay tile

L. Use overlapping tiles to continue marking, cutting, and installing border tiles until border is completed

(NOTE: Where border tiles fit against door casings and other intricate objects, you may have to heat the tiles in order to cut and make them fit properly.)

M. Clean up area and put away tools and equipment

FLOOR FINISHES
UNIT VI

TEST

NAME ______________________________ SCORE ______________

1. Match to their correct definitions terms associated with floor finishes. Write the correct numbers in the blanks.

_____a. Glue, cement, mastic, paste, or any substance capable of holding materials together by surface attachment	1. Underlayment
_____b. Plasticlike substance that is applied as a liquid and hardens to a durable finish; used both as underlayment and finish flooring	2. Resilient flooring
_____c. Material applied over subfloor to provide smooth surface for finish floor	3. Mastic
_____d. Adhesive used to attach finish flooring to subfloor	4. Epoxy (seamless flooring)
_____e. Material made of wood fiber formed into panels	5. Hardboard
_____f. Finish flooring that conforms to surface upon which it is laid	6. Adhesive

2. Name three types of underlayment for finish flooring.

a. ______________________________

b. ______________________________

c. ______________________________

3. Estimate the number of 4′ × 8′ sheets of underlayment needed to floor each of the rooms below. Show your work in the spaces provided. Write the correct answers in the blanks.

a. How many 4′ × 8′ sheets of underlayment are needed for a room that is 12′-0″ × 18′-0″?

Underlayment needed = ______________ sheets

TEST

b. How many 4′ × 8′ sheets of underlayment are needed for a room that is 15′ –0″ × 25′ –0″?

Underlayment needed = ________________________ sheets

c. How many 4′ × 8′ sheets of underlayment are needed for a room that is 14′ –0″ × 28′ –0″?

Underlayment needed = ________________________ sheets

4. Name four types of finish flooring.

a. ____

b. ____

c. ____

d. ____

5. List three factors to consider when selecting finish flooring .

a. ____

____

b. ____

____

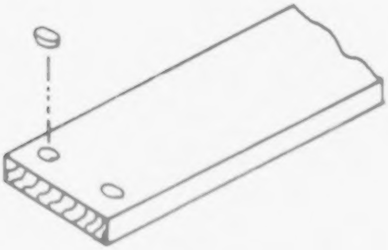
c. ____

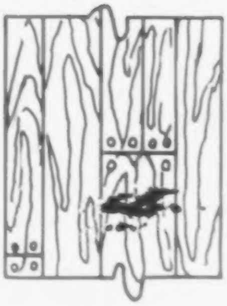
____

TEST

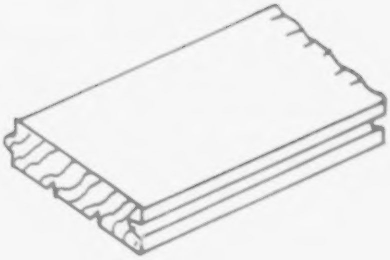
6. Identify the types of hardwood flooring illustrated below. Write the correct names in the blanks.

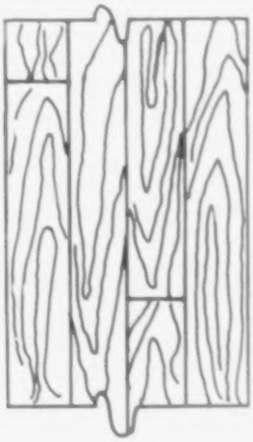
Strip flooring
Plank flooring
Parquet flooring
Block flooring





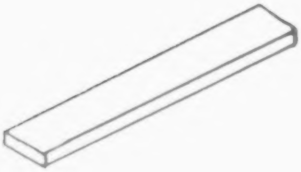
a. ____________________________

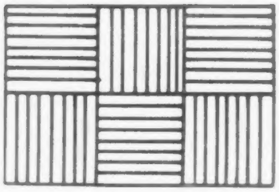




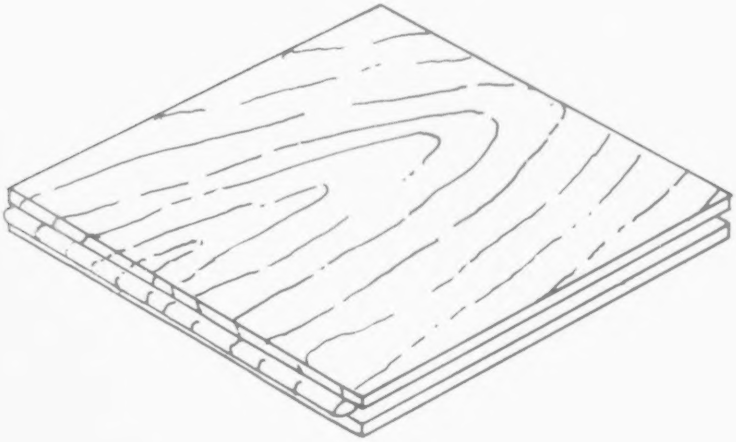
b. ____________________________

TEST





c. ______________________



d. ______________________

7. List four types of wood used for hardwood flooring.

a. ______________________

b. ______________________

c. ______________________

d. ______________________

8. Name three types of resilient flooring.

a. ______________________

b. ______________________

c. ______________________

TEST

9. Estimate the number of tiles needed to floor the rooms below. Write the correct answers in the blanks. Show your work in the spaces provided.

   a. How many 12″ × 12″ tiles will be needed to floor a room that is 10′ –6″ × 10′ –6″?

      Number of tiles = ____________________

   b. How many 9″ × 9″ tiles will be needed to floor a room that is 16′ – 0″ × 32′ – 0″?

      Number of tiles = ____________________

   c. How many 12″ × 12″ tiles will be needed to floor a room that is 10′ –6″ × 16′ –6″?

      Number of tiles = ____________________

(NOTE: Test question 10 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

10. Demonstrate the ability to

    a. Install underlayment.

    b. Install tongue-and-groove hardwood strip flooring.

    c. Install block flooring.

    d. Install resilient tile.

FLOOR FINISHES
UNIT VI

ANSWERS TO TEST

1. a. 6
   b. 4
   c. 1
   d. 3
   e. 5
   f. 2

2. Answer should include any three of the following

   a. Plywood
   b. Particle board
   c. Hardboard
   d. Wafer board
   e. Mastic
   f. Epoxy

3. (NOTE: Estimating answers may vary. The following answers are to be used only as guidelines.)

   a. 7
   b. 12
   c. 13

4. Answer should include any four of the following

   a. Hardwood
   b. Resilient tile
   c. Resilient sheet
   d. Clay tile
   e. Epoxy
   f. Carpeting
   g. Concrete

5. Answer should include any three of the following

   a. Type of flooring materials that are available
   b. Type of underlayment or base that has been installed
   c. Application method that will be used
   d. Material and installation cost limitations
   e. Conditions under which installation is to be made

6. a. Plank flooring
   b. Strip flooring
   c. Parquet flooring
   d. Block flooring

7. Answer should include any four of the following

   a. Beech
   b. Birch
   c. Hard maple
   d. Pecan
   e. Red oak
   f. White oak

ANSWERS TO TEST

8. Answer should include any three of the following

a. Asphalt	d. Vinyl
b. Cork	e. Vinyl asbestos
c. Rubber	

9. (NOTE: Estimating answers may vary. The following answers are to be used only as guidelines.)

   a. 121
   b. 681
   c. 187

10. Performance skills evaluated to the satisfaction of the instructor